Ref. Ares (2018)4843939 - 20/09/2018

Intelligent Fish feeding through Integration of ENabling technologies and Circular principle

Grant Agreement (GA) No: 818036

D4.2: Report on Social Acceptance Analysis; Public Report

Version: 2.0

Date: 08 August 2023

Document type:	**Report**
Dissemination level:	**Public**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818036

Project data

Project Title:	Intelligent Fish feeding through Integration of ENabling technologies and Circular principle
Project Grant Agreement (GA) No:	818036
Project Acronym:	iFishIENCi
Duration:	57 months, 1 November 2018 – 31 July 2023
Type of action:	Innovation Action

Deliverable Administration and Summary

Status:	Draft	**Due:**	07 February 2023	**Date:**	08. Aug. 2023
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Reviewer	Camilo Borgogno				
WP	4	**Deliverable Nr.**	**D19**	**Relative Nr.**	**4.2**
Comments					

Document change history

Version	Date	Author	Description
1.0	09.10.2020	Dorothy J. Dankel ERavagnan; ARost; JKobolák	First draft
1.1	09.06.23	DJDankel; ERavagnan	Consolidation of new draft from choice experiment and focus groups results NB! Du to institutional name change of one of our Hungarian partners, SZIU was re-named MATE in this document
1.2	29.06.23	DJDankel; ERavagnan; ARost	New results from Norway added, as well as Eye-tracking results from D4.14
1.3	12.07.2023	C. Borgogno	Review and inputs from WP5 survey.
2.0	08.08.2023	DJDankel	New draft after Reviewer Comments

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Suggested reference to this deliverable: D4.2: Report on Social Acceptance Analysis; Public Report (2023), Intelligent Fish feeding through Integration of ENabling technologies and Circular principle (iFishIENCi) Horizon 2020 project under Grant Agreement (GA) No: 818036

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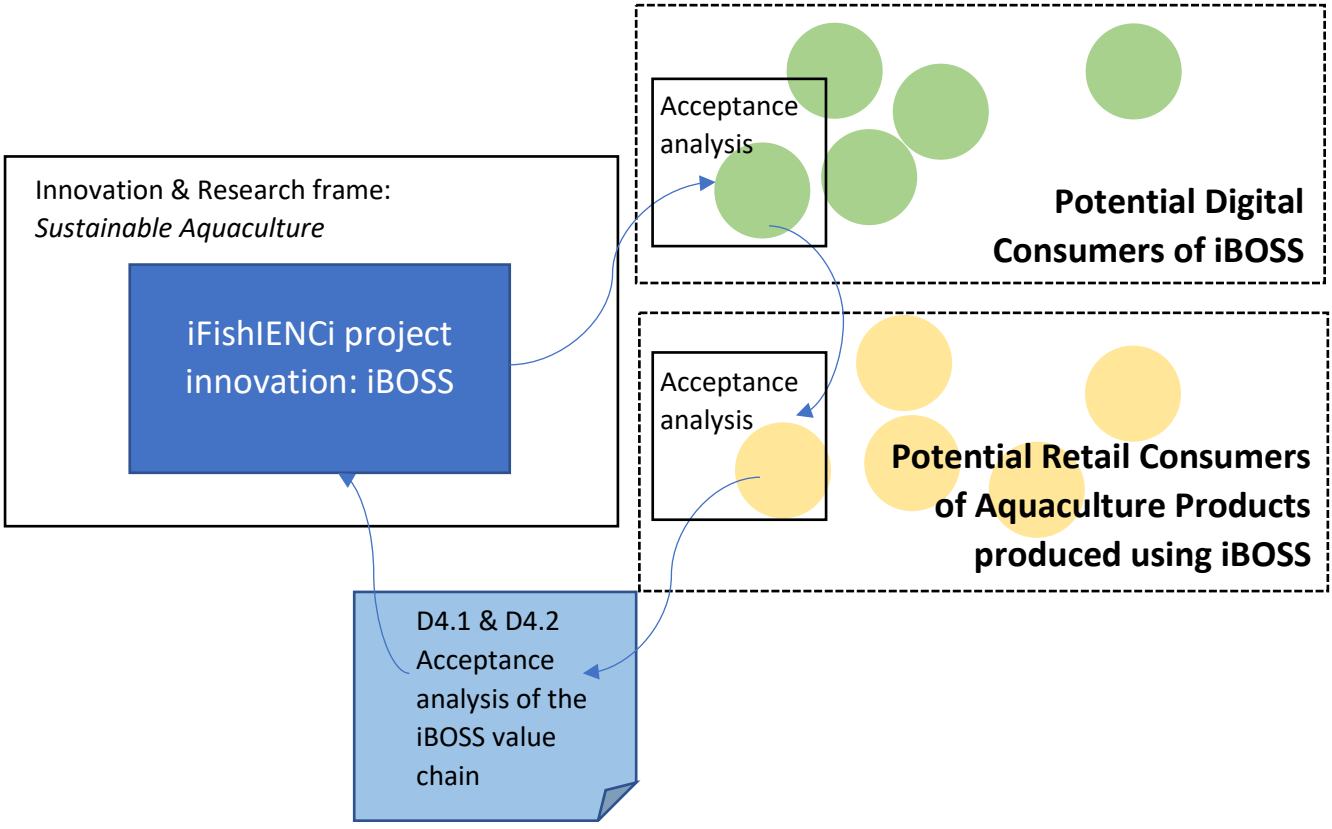
1 Social Acceptance Analysis in the iFishIENCi project

The Research and Innovation Action project, iFishIENCi, developed several different innovations to support the concept of "sustainable aquaculture." In order to support the Sustainability and Circularity Assessments in Work Package 4, the University of Bergen lead Task 4.1: Social acceptance analysis [M1-M47] (Lead: UiB, Contributors: ABT, MATE, TTZ, NORCE).

The social acceptance analyses that we conducted contained two main stakeholder groups:

1. Digital Consumers of the iBOSS innovation product
2. Retail Aquaculture product consumers

The iFishIENCi project has a central innovation frame of Sustainable Aquaculture, in which the digital innovation of iBOSS is developed. Only if aquaculture producers accept and "take-on" iBOSS can we analyze the social acceptance via the retail Aquaculture Product Consumers. Therefore, it is important for us to explicitly separate these consumer groups since one is dependent on the other. To put this another way, in order to analyze "acceptance" of the digital innovation of iBOSS by retail Aquaculture Product Consumers, we must first analyze the acceptance of the Digital Consumers to iBOSS. We illustrate these value chain interdependencies in the following figure:



We first applied qualitative studies (interviews, focus groups) to investigate the underlying deeper attitudes, values and trusts towards the dimension of sustainability. Based on the outcomes of the qualitative studies, we designed choice experiments to investigate the impact of the following different sustainability labels/characteristics:

a) **Willingness to buy**: food labels, end-consumer aquaculture fish products.

b) **Willingness to pay**: both iBOSS and circularity + end-consumer aquaculture fish products.

1.1 Previous knowledge

There is a multitude of existing knowledge on the attitudes of consumers towards fish and seafood products from sustainable aquaculture. Here are some salient points on what we already know about consumer behaviour:

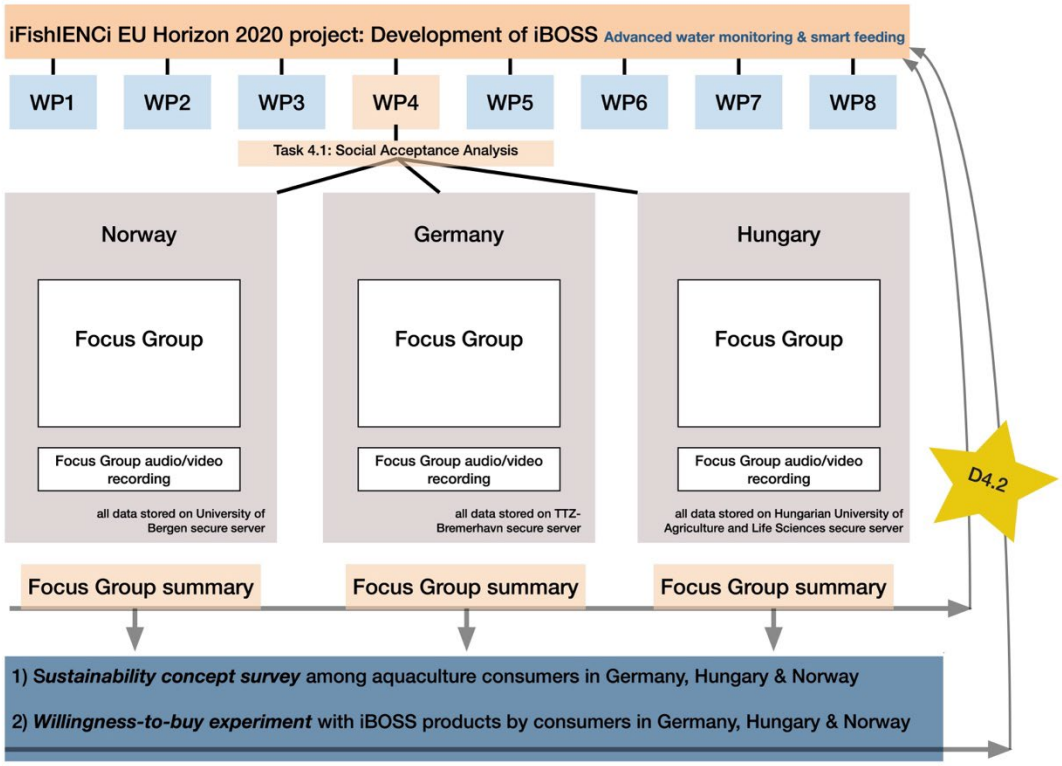
- Sustainability is important for consumers, but not of high importance for purchasing decisions (same as origin, exception: local products), quality and price are main aspects
- Consumers are unfamiliar with labelling schemes and do not trust them very well
- Negative attitudes: consumers compare aquaculture with intensive livestock farming they know, such as cattle, poultry; use of antibiotics; environmental impacts
- Knowledge about aquaculture farming is relatively low

➔ strategies to increase consumer awareness and acceptance should start at consumer's current perception of sustainable aquaculture and build up knowledge of aquaculture production

2 Results of the Focus Groups

In iFishIENCi Deliverable 4.1, we outlined the main methods we applied for our Social Acceptance Analyses. The first method is qualitative Focus Groups for some self-selected Digital Consumers in Norway and Belgium/Indonesia and Retail Consumers and Technology Users in Germany, and fish farmers in Hungary. The next analysis was an experiment to determine the market indicators of Willingness to Buy & Pay.

We illustrated a visual summary of our work-flow and methods below:



2.1 Results of the Technology Developers Focus Group Discussion

We conducted 2 rounds of a Focus Group with companies that are currently developing or using digital products in aquaculture.

In the first round of the focus group of Technology suppliers was held June 14, 2021 and Second round on April 8, 2022 on Zoom/Teams.

Prior to these focus groups, we conducted a test interview (April 17, 2021) with the question protocol for the focus group. This interview was with Sverre Marvik who is the CEO of Anteo, a small Norwegian technology company for aquaculture industry. Anteo provides software and service for providers like well boats and feed boats, as well as software for farmers and fish health. We concluded from that successful test interview that our questions were sufficiently formulated and broad to engage this stakeholder segment.

We fully transcribed the Focus group discussions, and the following table summarizes the most relevant questions and comments. The Agenda of the Focus Group Round 1 was:

- Tour de Table introductions
- Introduction to iFishIENCi by Dorothy Dankel and Elisa Ravagnan
- Topic 1: “sustainable aquaculture”
- Topic 2: “digital technology”
- Topic 3: “data sharing and security”
- Topic 4: “expectations and needs from precision aquaculture”
- any other topics of concern
- conclusions, expectations and setting date for Round 2 (Early 2022)

Participant	**Afffiliation**

Barbara Hostins	INVE Aquaculture (International)
Stefano	INVE Aquaculture (International)
Martin Gausen	Oxyvision (Norway)
Klaus Hoseth	Stranda Prolog (Norway)

The results were discussed in a workshop in Bergen on December 6, 2021 with Franck de Gall (EGM), Elisa Ravagnan (NORCE), Dorothy Dankel (UiB) & Maria Ejarque (UiB/ERAMSUS intern). In this workshop, we went through the First Round Tech suppliers' questions and collaboratively figured out a way to get concrete feedback from the stakeholders in Round 2.

In the second round (April 2022), we wanted to get user feedback into the modules currently in development for iBOSS. We had the same particpants (minus Klaus) opened with a short re-cap of what iBOSS is and then showed a worked example with the HCMR iBOSS set-up in Crete.

We presented the participants with module categories used in the iBOSS prototype (columns) and the various solutions (rows):

Data	**Data model**	**Interface**	**Hosting**	**Algorithm**
Own data (1)	Their own (closed) (4)	Only in (7)	Local (on premises) (10)	Own (12)
Shared (closed community) (2)	Shared (closed community) (5)	Only out (8)	Cloud (SAAS) (11)	Plug-in (13)
Open (certain conditions) (3)	Open (6)	In/out (9) (they decide how they interact platform)		On demand (Hired a 3rd party) (14)

We then presented the in vivo demonstration of iBOSS from Crete, based on on-going results from HCMR. In Crete, the following solutions (highlighted in green) are currently in operation:

Data	Data model	Interface	Hosting	Algorithm
Own data (1)	Their own (closed) (4)	Only in (7)	Local (on premises) (10)	Own (12)
Shared (closed community) (2)	Shared (closed community) (5)	Only out (8)	Cloud (SAAS) (11)	Plug-in (13)
Open (certain conditions) (3)	Open (6)	In/out (9) (they decide how they interact platform)		On demand (Hired a 3rd party) (14)

Based on the summary of the iBOSS demonstration, we then asked the participants for feedback on the question: "How would you design *your* iBOSS?"

For Oxyvision, they expressed that it would be helpful to have incentives for their clients (aquaculture farmers) to increase amount of data. We received more detailed feedback from INVE Aquaculture as they were able to spend extended time in the focus group:

Data	Data model : *dependent on how much data and Time one has/helpful to have incentives to increase amount of data*	Interface: *depends on the knowledge/expertise level of employees*	Hosting	Algorithm
Own data (1)	Their own (closed) (4)	**Data only in (7)** (no interaction with the platform/system)	**Local (on premises) (10):** ***probably best for a large farm***	**Own (12) Tuning with your specific solution/spp.** ***This option if you have a lot of data yourself***
Shared (closed community) (2) : ***depending on the company***	Shared (closed community) (5)	**Data only out (8)** (results are tuned with someone else's data) ***this is the easiest solution***	**Cloud (SAAS) (11):** ***easy for maintenance, need to guarantee a WIFI connection, or back-up***	**Plug-in (13):** ***like this option***
Open (certain conditions) (3)	Open (6)	**In/out (9) (they decide how they interact with platform)** ***this is the most interesting, but requires most expertise***		**On demand (Hired a 3rd party) (14)** A "locked" product

The results from this Focus Group were then discussed with our iFishIENCi colleagues in WP2 and WP3 as part of the RRI feedback of user needs into the further design of iBOSS as a responsible and sustainable innovation.

2.2 Results of the Focus Group of Retail Consumers of Aquaculture in Germany

With the focus group discussions with retail consumers of aquaculture products, we collected information about participants' familiarity with and relation to:

- sustainable aquaculture (attitudes, knowledge, consumer needs' regarding transparency) and fish and seafood products from sustainable aquaculture
- technological aspects of sustainable aquaculture farming

In addition, we collected information about participants' attitudes towards:

- new technologies: the incorporation of digital technology in aquaculture systems (knowledge, advantages, concerns, reservation, excitement)
- communication (practices/lack of): consumer demands/needs (what kind of information they need to see benefits/advantages for them/society)

Focus Group conducted by ttz, Germany, 18.03.2021 and 19.03.2021

Target group:

- Age: 18-40
- Regular fish consumers
- 30% have kids in their household
- Awareness of sustainability labels: know either ASC or MSC label

Due to the social distancing constraints in the current COVID-19 pandemic focus groups were conducted in a digital format. We have developed a protocol concept to create a comfortable atmosphere for all participants. As a start, a general introduction to the project was given. The aim of today's discussion was explained. (What is aquaculture, showing different fish species, which are part of the project, why do we need aquaculture, fish consumption/ need for protein to provide future generations with enough protein). At the beginning, general questions about aquaculture were asked.

Young consumers associate with aquaculture particularly strict controls, safe processing, sustainability, animal welfare, healthier animals. They have doubts about animal welfare, space, use of antibiotics. They are concerned about the environment, have doubt about standards. Hardly any knowledge about any aquaculture other than for salmon.

The term sustainability is strongly associated with the protection of wild stocks and the protection of ecosystems. The trust in companies towards their sustainable and responsible actions is rather low. Sustainability labels should be revised and consumers ask for more transparency.

Focus on animal welfare, feeds should be as good as from the sea, strict control of sustainable standards, environment should not suffer. Ideas and wishes: politically promotion of sustainable aquaculture, more education of children and consumers, possibilities to find out more about sustainable aquaculture in supermarkets

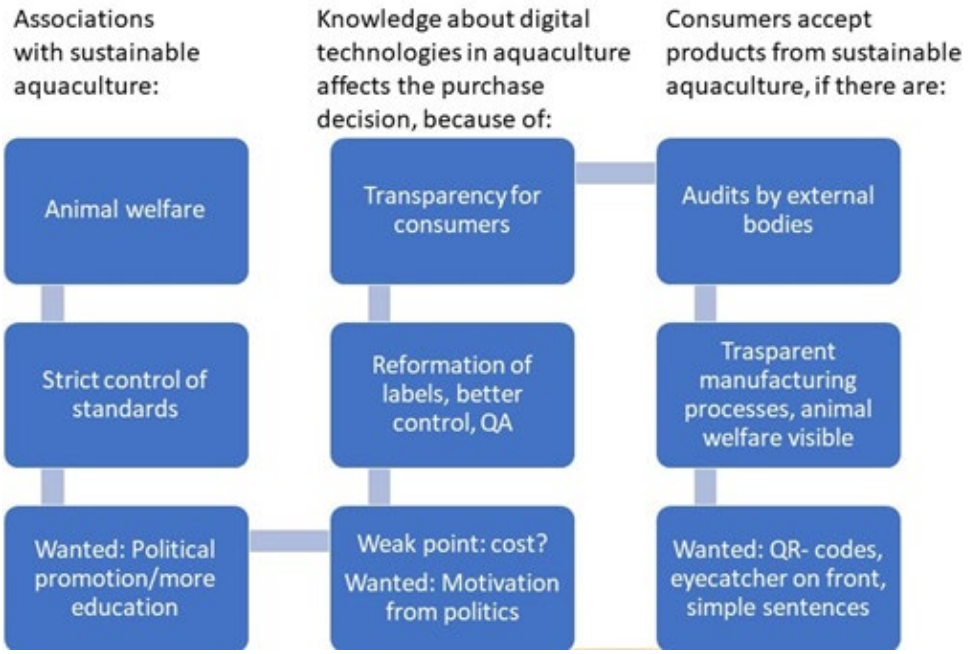
Digitalization is seen as an instrument to lead to more transparency for the consumer, making farm to fork visible. Digitalization could reform labels, better control and quality assurance in aquaculture.

Young consumers gave very positive feedback to the iBOSS technology. They see weak points for consumers: costs (especially for small companies). Their ideas and wishes are that the motivation has to come from politics (top-down influence).

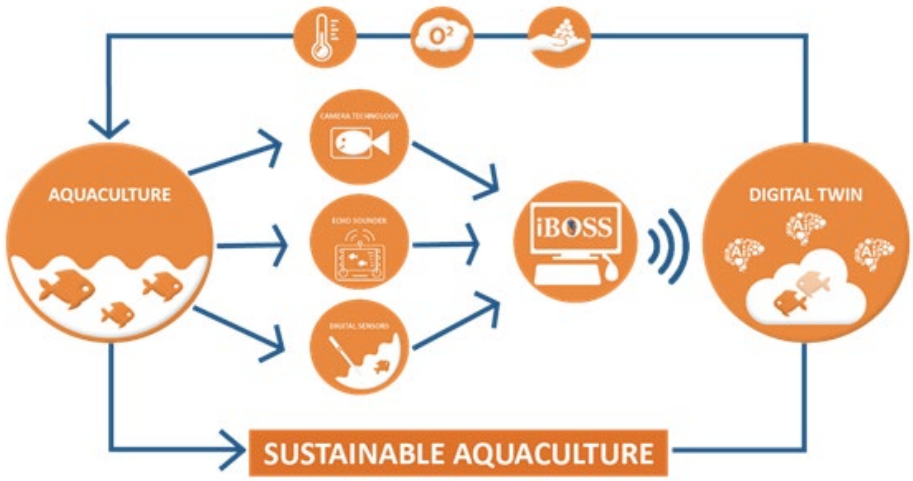
The use of digital technologies have a positive influence on young consumers' purchasing behavior. For them, digital technologies are very positive, support sustainability, animal welfare, and control of standards. Consumers would pay more (theoretically).

Young consumers' ask for audits by external bodies and transparent manufacturing processes to accept products from sustainable aquaculture. They like to get information on how the aquaculture system looks like (photos and schematic drawings). In addition, animal welfare should be visible. As far as communication tools, young consumers could imagine QR-codes, eyecatchers on front of the food packages.

Summary:



iBOSS was introduced to the participants:



Young consumers were asked how they feel about the information they just got.

They felt well informed and were impressed by the system. They see positive aspects regarding animal welfare, the environment and for themselves as consumers. To implement iBOSS in aquaculture systems, the motivation must come from the politics. Consumers fear that only large companies can afford such a system, the technology must be affordable and monopoly positions should be avoided.

2.3 Results of Focus groups with Technology Users in Germany

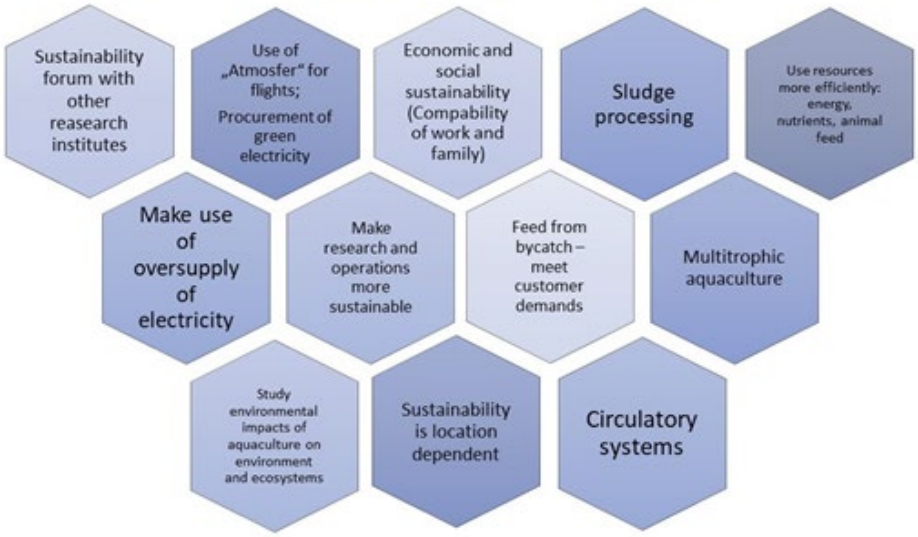
ttz, Germany, April 2021

Target group:

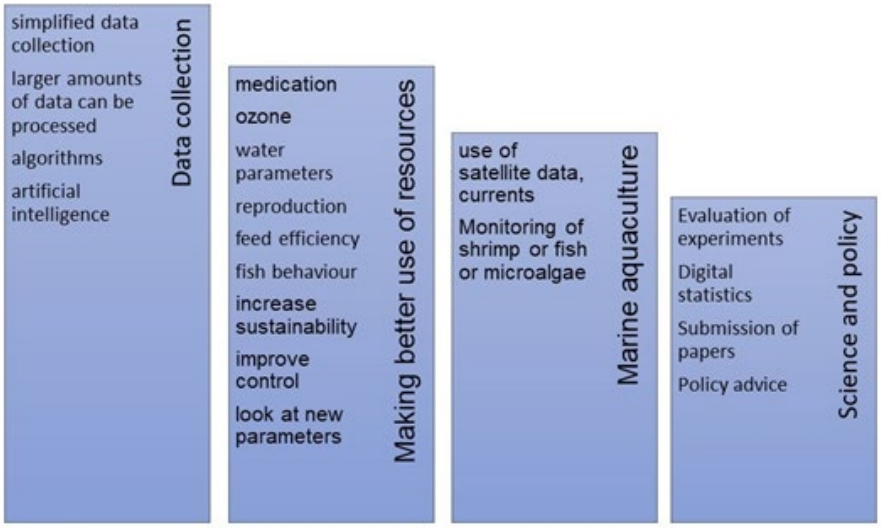
- FraunhoferResearch and Development Center for Marine and Cellular BiotechnologyAquaticCellTechnology & Aquaculture Mönkhofer Weg 239 a23562 Lübeck Germanyhttp://www.emb.fraunhofer.de/
- Alfred Wegener Institut, Knowledge and Technology Transfer -AquacultureResearch Group Am Handelshafen 12 27570 Bremerhaven Germanywww.awi.de
- ThünenInstituteInstituteofFisheriesEcology Herwigstraße3127572 Bremerhaven Germanyfi@thuenen.de
- Rent a Fishman Fischwirtschaftsmeister /Fishing master, 14828 Görzke, Germany, www.rent-a-fishman.de

Due to the social distancing constraints in the current COVID-19 pandemic focus groups were conducted in a digital format. We described sustainability in different ways with focus on social, ecological and economic sustainability.

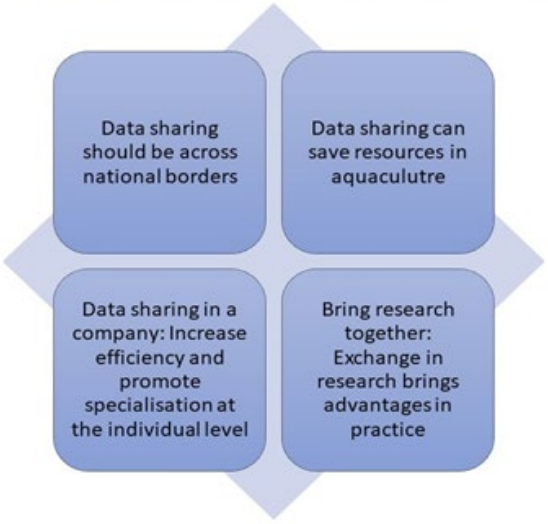
1. What is your definition of "Sustainability" that you or your company use?



2. What is digitalization to you in your company? Can you formulate an example?



3. How can data-sharing and "digital technology" help you achieve sustainability goals in your company?



2.4 Results of the Focus Group in Hungary with Fish Farmers

The first round of the focus group in Hungary, with technology users such as fish farmers and fish processing industry members, was held September 3rd and 10th 2021 through an online platform.

The focus group interviews in Hungary were performed similarly to the Norwegian and German sites. The short project information, the GDPR information sheet, and the statement were translated to Hungarian and the GDPR expert of the University (MATE) approved it before consenting. The interviews were performed and recorded according to the GDPR rules. The recordings are saved on the server of MATE-AKI in a designated project folder.

Due to the limited size of the industry in Hungary, technology user focus groups were different in composition, inviting different technology users.

The focus of the questions was about digitalisation, data sharing, sustainability, and circularity, in accordance with Norwegian and German studies.

Questions:

- What level of digitalization does your company apply? Can you give us an example?
- What are the advantages or disadvantages of digitalisation in fisheries and fish production?
- What are the benefits and dangers of introducing digital-based technologies?
- What do you think of data sharing anonymously, where multiple fisheries can make decisions based on each other's data? Do you think such a solution is conceivable?
- What does sustainability mean for you and your company?
- Can you give us an example of when you're acting sustainably?
- How can the industry switch to circular farming?
- How important do you think it is in the customer's decision whether the product you buy comes from a sustainable source?

Conclusions of the Interviews:

Overall, the attitude of invited technology users (mainly SME's) was very positive and showed a great interest in the iFishIENCi project and the technologies under development. Although the Hungarian fishery sector and especially the extensive pond systems are very sensitive for costs, and they cannot allow significant investments, all of them stated if they would have financial possibilities they would invest more into digitalisation and digital technologies. Intensive technology-based fisheries however already apply a given level of automatization and digital technologies. Their interest was clear and engaged with digitalisation.

Although the users see some threat to trust in the technology, they are willing to share production data in case if they would retain anonymity and get useful information from the collected and analysed data. It was obvious during the discussions that the "next generation" of professionals are more open to the new technologies and have more willingness to apply them in their business. As a conclusion, they expressed their interest to know more details about the new developments in another round of discussion or even visit test sites to understand the benefit of the new technologies.

The incorporation of digital technology could improve:

- the optimisation of the usage of resources,
- data collection to increase production and decrease/optimise costs,
- optimise production chain.

- would be helpful to get data from other farms/farmers in an anonymous way and make predictions;
- to compare production data with other farms/farmers within the country and maybe in the geographic region (under similar conditions);
-

Limitations of the spread of the technology:

- lack of qualified workforce
- price of integrating new technologies – price-sensitive local market, majority of farms are extensive pond-based
- the willingness of data-sharing among farmers/farms in the sector
- transparency – would be important but difficult to check
-

In the case of extensive pond systems – mainly producing carp – sustainability is realising, however, for intensive systems (e.g. RAS) it is difficult to obtain sustainability at every aspect of the technology, considering price-sensitive consumers on the Hungarian market. Although awareness is increasing, both in the case of sustainability and circularity, still the price of the product dictates on the market, therefore, producers prefer less expensive technologies over the sustainable or circular economy.

3 Results of Qualitative studies to investigate the underlying deeper attitudes, values and trusts towards the dimension of sustainability

3.1 iBOSS

For the Hungarian consumer **iBOSS** is easy to understand. Consumers are rather in favour of this than against it. They see it as a rather wise and a good idea than a bad idea. The German consumer draws a similar picture, but not as positive as the Hungarian consumer. The benefits are seen similar, again the Hungarian consumer is more positive than the German consumers (positive answers given: likely and very likely). Question given: According to your beliefs, how likely or unlikely do you think it is for this new method to have the following benefits? *(scale from very unlikely; unlikely; neither/nor; likely; very likely)*

iBOSS	Hungarian Consumers	German Consumers	Norwegian Consumers
Personal benefit	59%	53%	24%
Benefit for human health	76%	61%	40%
Beneficial for environment	87%	69%	54%
Reduces suffering of livestock	81%	62%	48%
Beneficial for national economy	81%	60%	38%

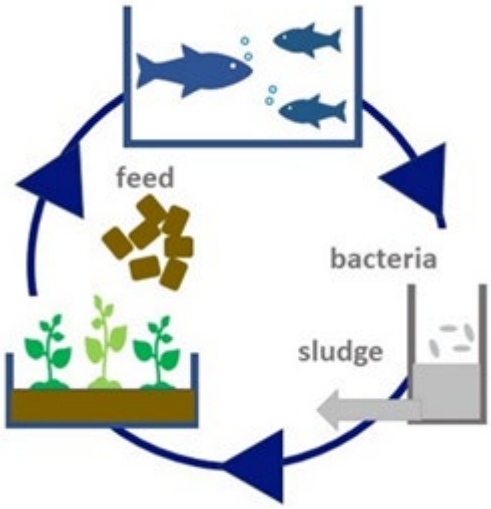
Percentage given: *sum of answers "likely; very likely"*

The following table shows to which extent consumers are concerned about the risks related to iBOSS. Question given: To what extent are you concerned about the risks related to this production method? *(scale from very concerned; a little concerned; not concerned))*

iBOSS	Hungarian Consumers	German Consumers	Norwegian Consumers
Risks concerning human health and food safety	15%; 31%	19%;46%	10%; 47%
Risk of unpredicted negative effects on environment	24%; 48%	24%; 48%	11%; 57%
Risk of being misled by food companies	31%; 47%	22%; 57%	23%; 54%
Other risk	10%; 50%	13%; 50%	NA

First number "very concerned", 2nd "a little concerned"

3.1.1 Circularity



The Hungarian consumers had a positive opinion about the described **circularity** approach. 40-50% of the consumers are *very in favour of this, think it's wise, think it's a very good idea.* The German consumers are not as positive as the Hungarian consumers, 30-40% of the consumers are *very in favour of this, think it's wise, think it's a very good idea.* The benefits are seen not that different, again the Hungarian consumers is a bit more positive than the German consumers (positive answers given: likely and very likely). The Norwegian consumer are positive to circularity, even if less enthusiastic than those surveyed in Germany and Hungary.

Question given: According to your beliefs, how likely or unlikely do you think it is for this new method to have the following benefits? *(scale from very unlikely; unlikely; neither/nor; likely; very likely).*

Circularity	Hungarian Consumers	German Consumers	Norwegian Consumers
Personal benefit	59%	52%	23%
Benefit for human health	57%	57%	33%

Beneficial for environment	59%	54%	59%
Reduces suffering of livestock	54%	54%	20%
Beneficial for national economy	85%	63%	46%

Percentage given: *sum of answers "likely; very likely"*

The following table shows to which extent consumers are concerned about the risks related to circularity.

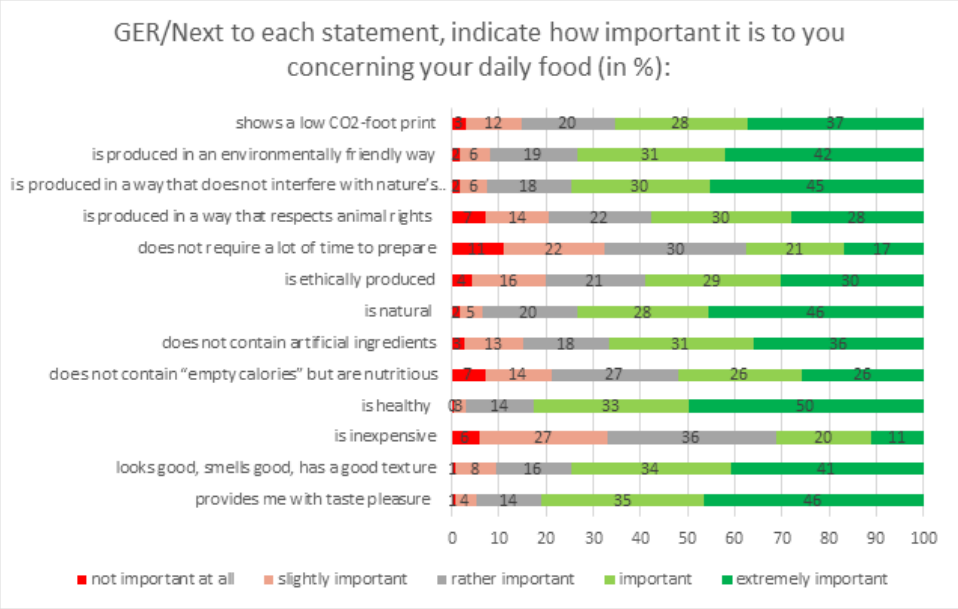
Question given: To what extent are you concerned about the risks related to this production method? *(scale from very concerned; a little concerned; not concerned))*

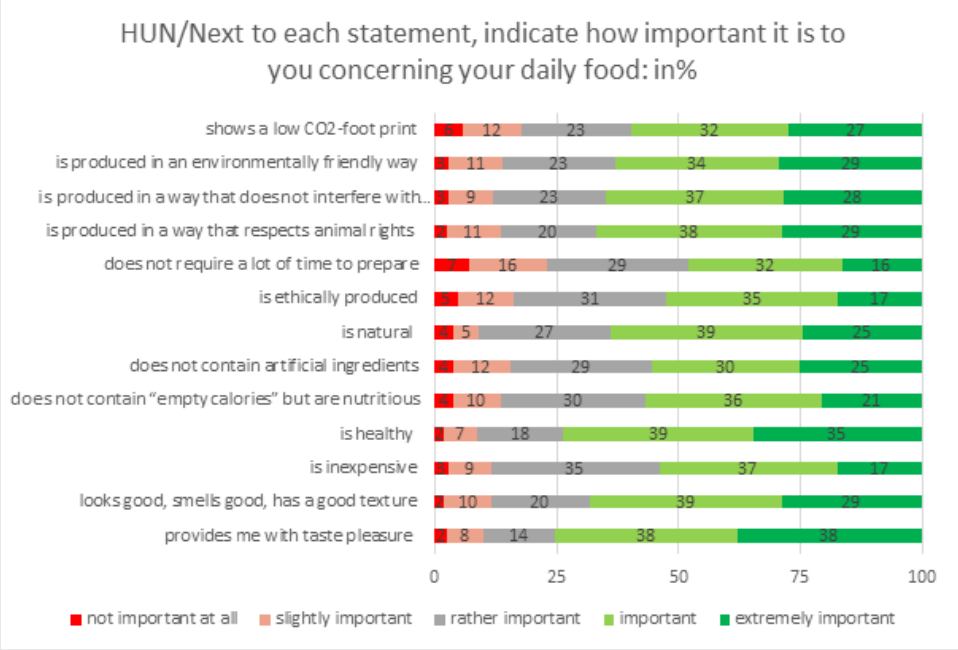
Circularity	Hungarian Consumers	German Consumers	Norwegian Consumers
Risks concerning human health and food safety	17%; 36%	11%;49%	16%; 22%
Risk of unpredicted negative effects on environment	13%; 46%	17%; 48%	12%; 20%
Risk of being misled by food companies	25%; 44%	18%; 45%	7%; 13%
Other risk	9%; 49%	11%; 49%	NA

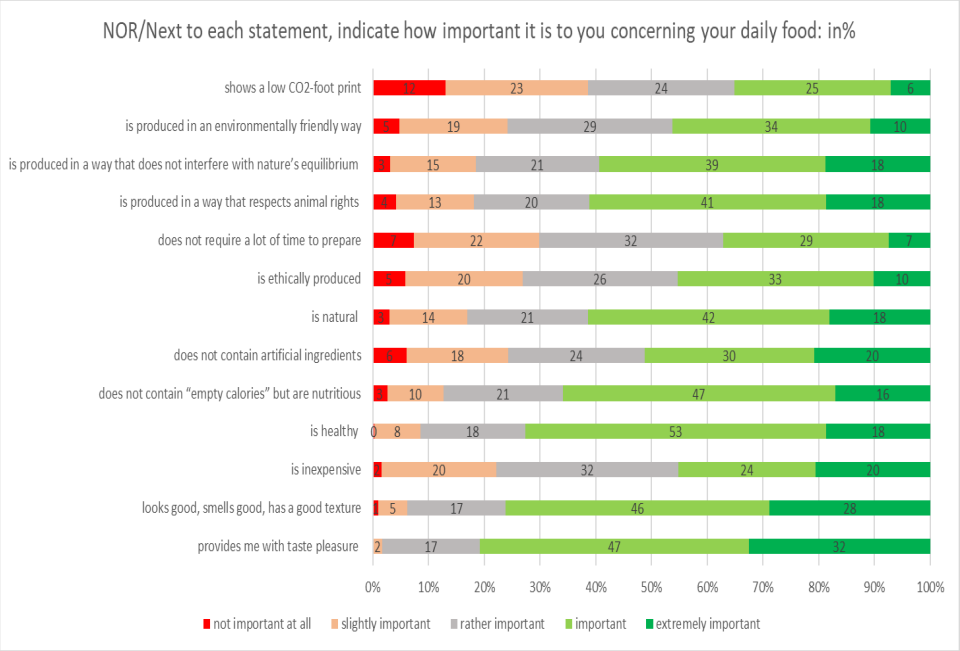
1st number "very concerned", 2nd number "a little concerned"

3.2 General food attitudes

Consumers were asked about the importance of different statements with respect to their daily food. Answers in Hungary and Germany were very similar. A low CO2-foot print, sustainable ways of production and production ways which do not interfere with nature's equilibrium are important. Norwegians too evaluate positively a sustainable production, as well as the sensorial attractiveness.

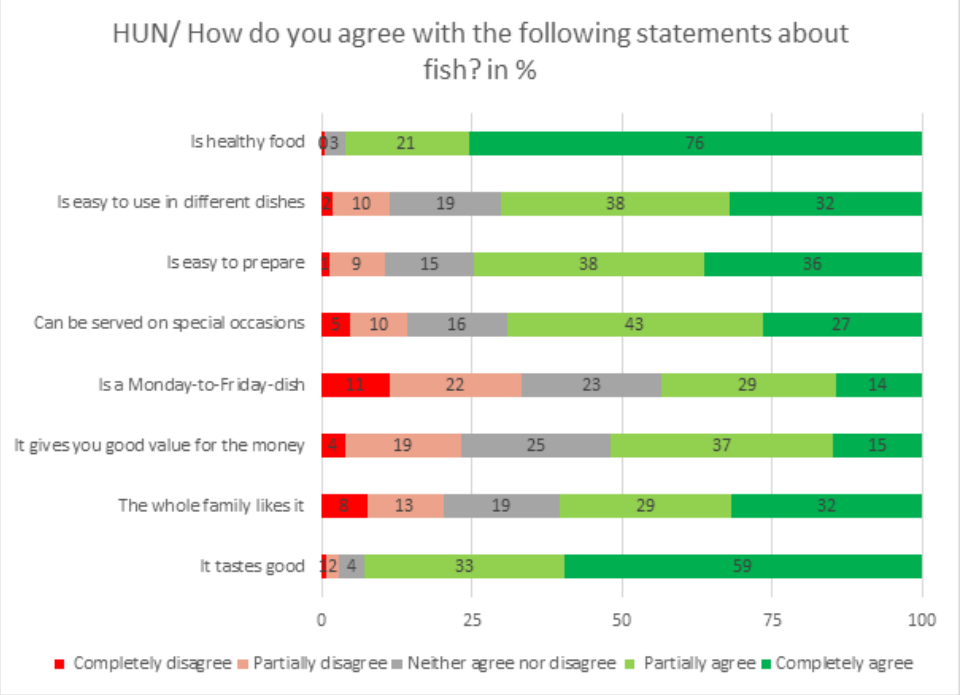

GER/Next to each statement, indicate how important it is to you concerning your daily food (in %):
shows a low CO2-foot print
is produced in an environmentally friendly way
is produced in a way that does not interfere with nature's..
is produced in a way that respects animal rights
does not require a lot of time to prepare
is ethically produced
is natural
does not contain artificial ingredients
does not contain "empty calories" but are nutritious
is healthy
is inexpensive
looks good, smells good, has a good texture
provides me with taste pleasure
0 10 20 30 40 50 60 70 80 90 100
not important at all
slightly important
rather important
important
extremely important

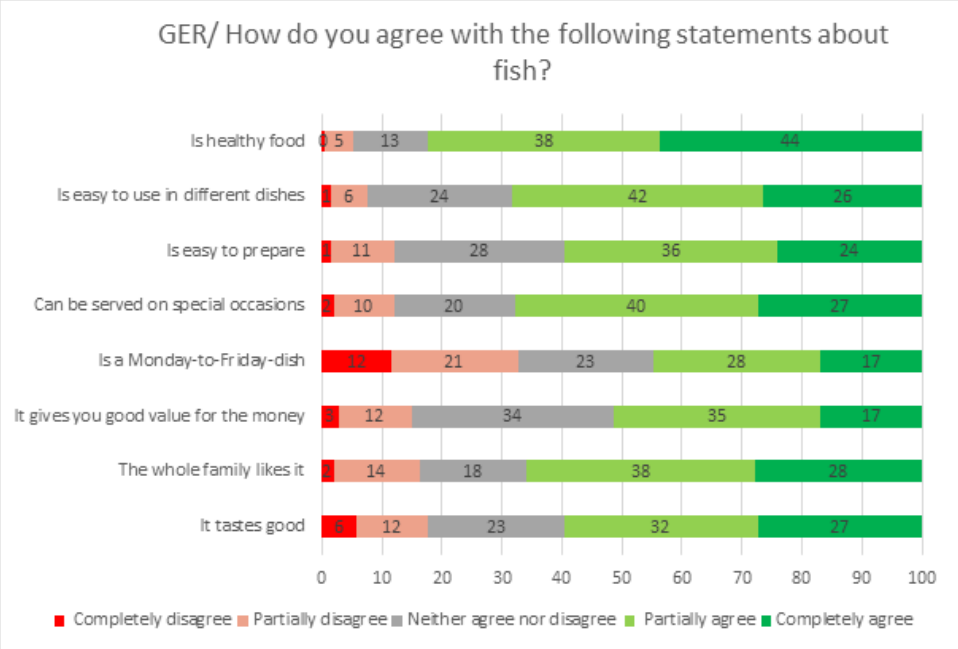

HUN/Next to each statement, indicate how important it is to you concerning your daily food: in%
shows a low CO2-foot print
is produced in an environmentally friendly way
is produced in a way that does not interfere with...
is produced in a way that respects animal rights
does not require a lot of time to prepare
is ethically produced
is natural
does not contain artificial ingredients
does not contain "empty calories" but are nutritious
is healthy
is inexpensive
looks good, smells good, has a good texture
provides me with taste pleasure
0 25 50 75 100
not important at all
slightly important
rather important
important
extremely important

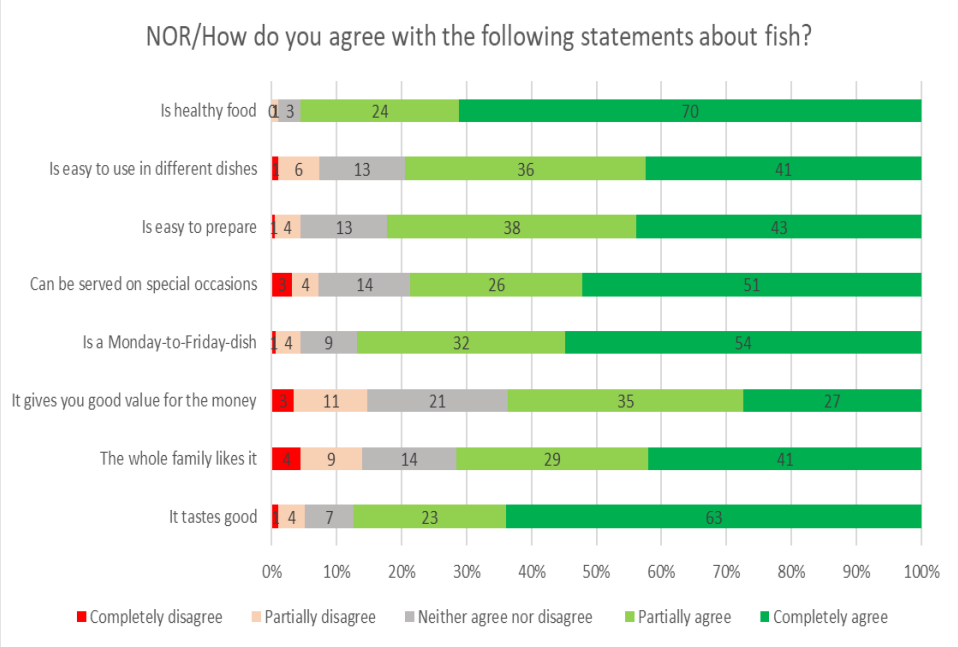


3.3 Attitudes towards fish

Fish is seen in Hungary as a healthy food by 76% (completely agreement) as in Norway (70%). In Germany only 44% of the consumers completely agree to this statement.

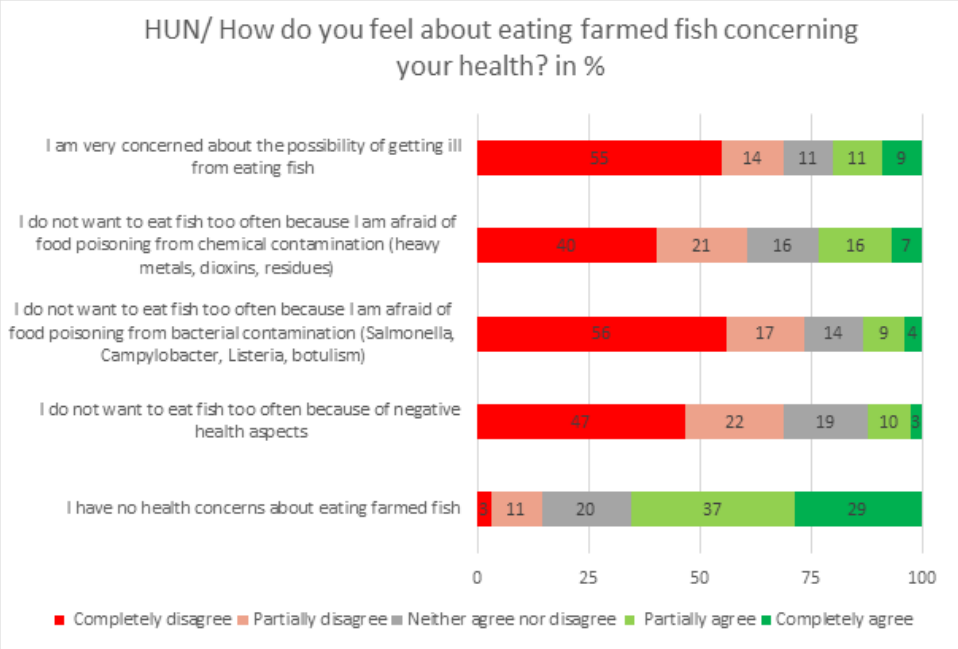


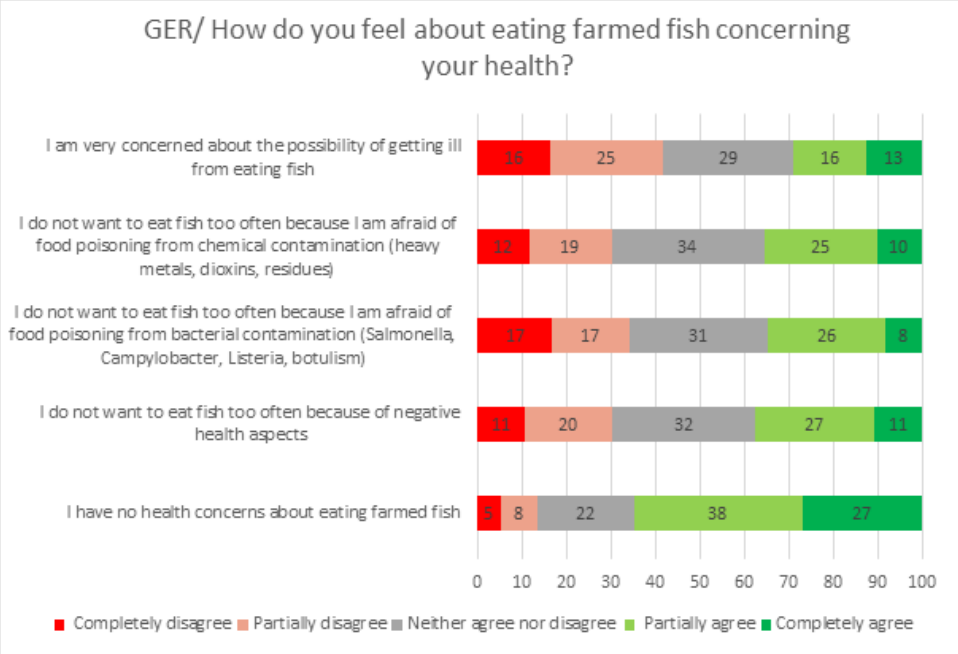


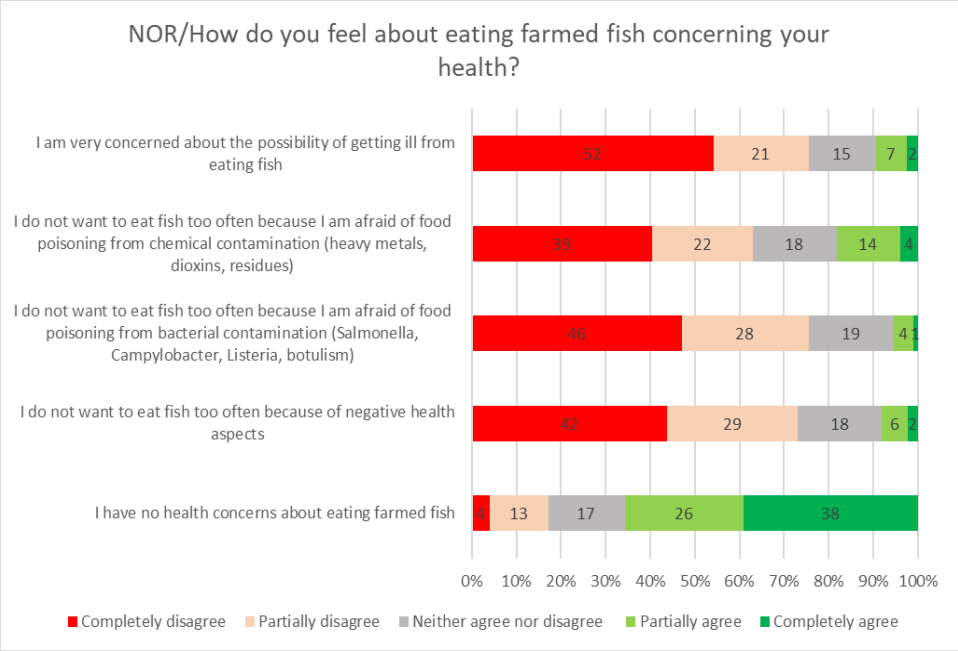


3.4 Health concerns eating farmed fish

Health concerns “in general” are of similar relevance for Hungarian and German consumers. German consumers are much more afraid of food poisoning from chemical contamination and from bacterial contamination than the Hungarian consumer. A large number of Norwegian consumers have no health concerns for eating fish (38%).

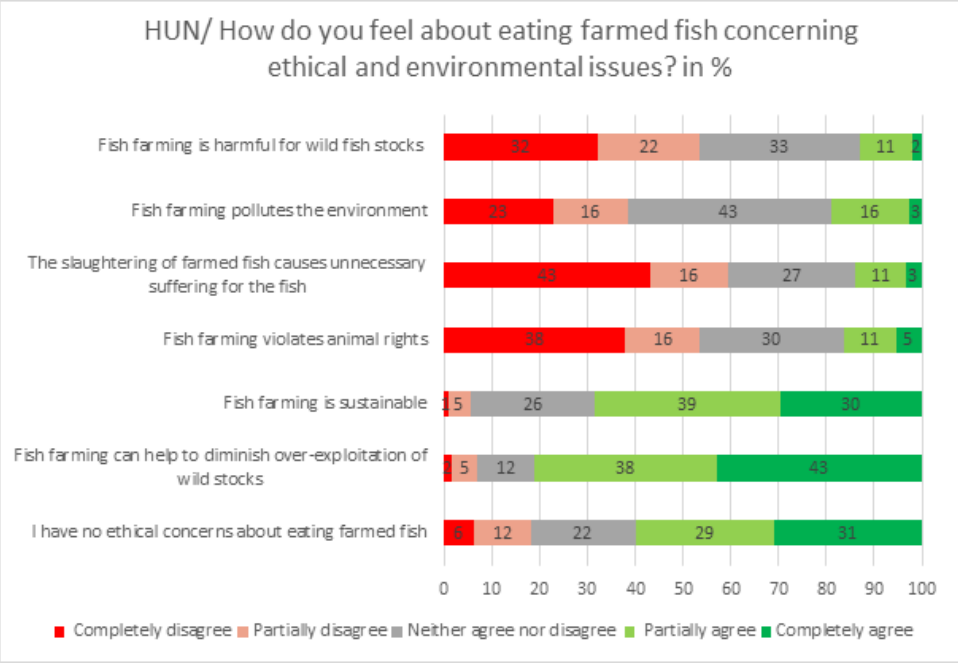

HUN/ How do you feel about eating farmed fish concerning your health? in %
I am very concerned about the possibility of getting ill from eating fish
55
14
11
11
9
I do not want to eat fish too often because I am afraid of food poisoning from chemical contamination (heavy metals, dioxins, residues)
40
21
16
16
7
I do not want to eat fish too often because I am afraid of food poisoning from bacterial contamination (Salmonella, Campylobacter, Listeria, botulism)
56
17
14
9
4
I do not want to eat fish too often because of negative health aspects
47
22
19
10
3
I have no health concerns about eating farmed fish
3
11
20
37
29
0
25
50
75
100
Completely disagree
Partially disagree
Neither agree nor disagree
Partially agree
Completely agree

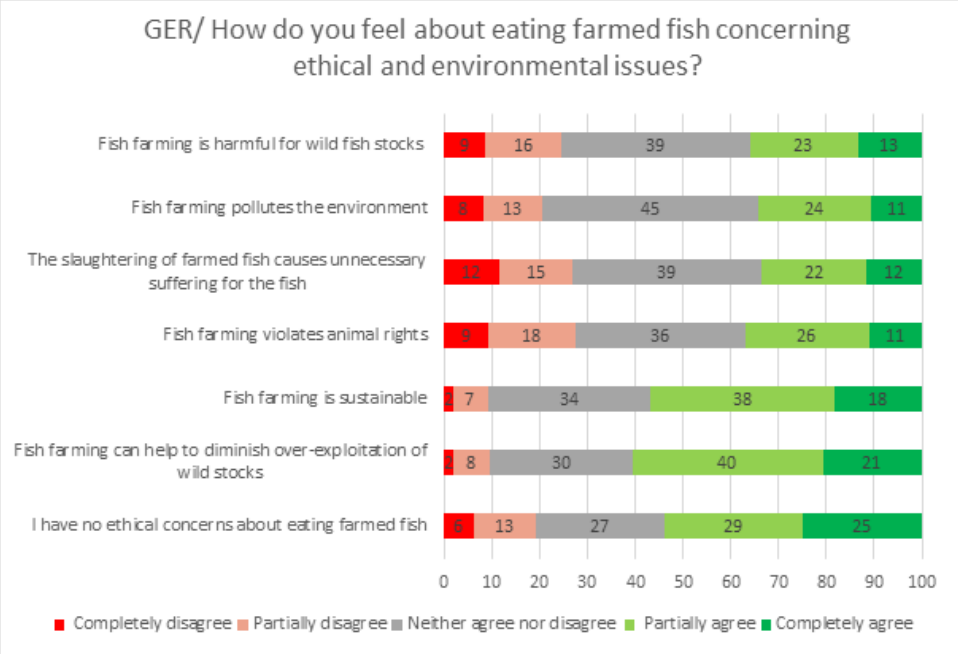

GER/ How do you feel about eating farmed fish concerning your health?
I am very concerned about the possibility of getting ill from eating fish
16
25
29
16
13
I do not want to eat fish too often because I am afraid of food poisoning from chemical contamination (heavy metals, dioxins, residues)
12
19
34
25
10
I do not want to eat fish too often because I am afraid of food poisoning from bacterial contamination (Salmonella, Campylobacter, Listeria, botulism)
17
17
31
26
8
I do not want to eat fish too often because of negative health aspects
11
20
32
27
11
I have no health concerns about eating farmed fish
5
8
22
38
27
0
10
20
30
40
50
60
70
80
90
100
Completely disagree
Partially disagree
Neither agree nor disagree
Partially agree
Completely agree

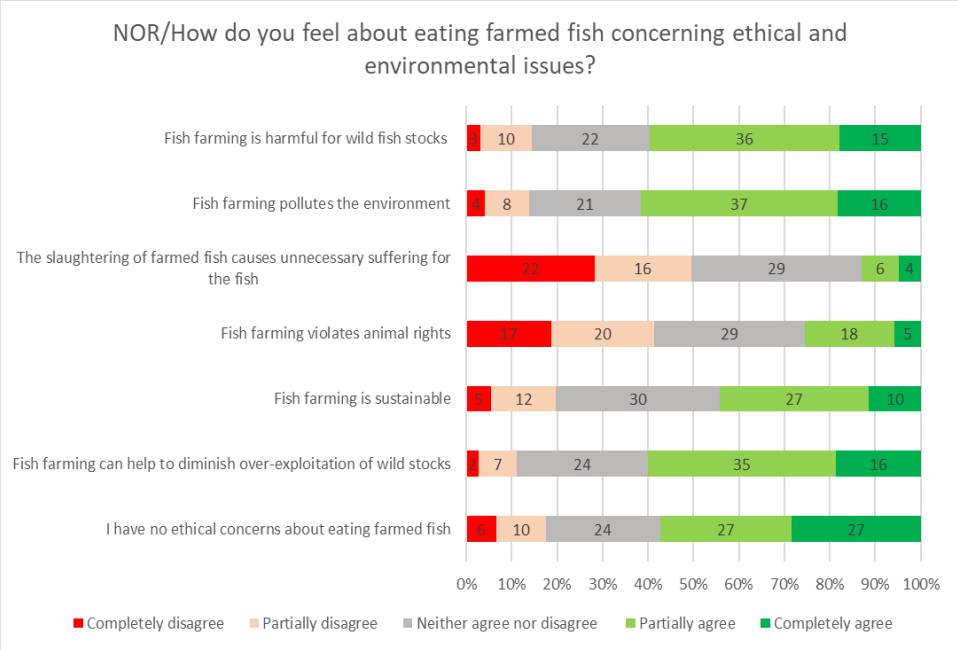


3.5 Ethical and environmental concerns eating farmed fish

Ethical concerns are more prominent than health concerns (wild stocks, pollution, animal rights) to the Hungarian consumer. Fish farming is sustainable for 69% (partially agreement plus complete agreement) of the Hungarian consumers. 56% of the German consumers state that. The German consumers see a danger for wild fish stocks, the environment, unnecessary suffering for the fish and the violation of animal rights (34-37% partial and complete agreement). In Hungary only 13-19% of the consumers have the same opinion. Norwegian consumers have in general little concerns about eating farmed fish, the major concerns are towards the negative effects on the wild population and the environmental pollution.





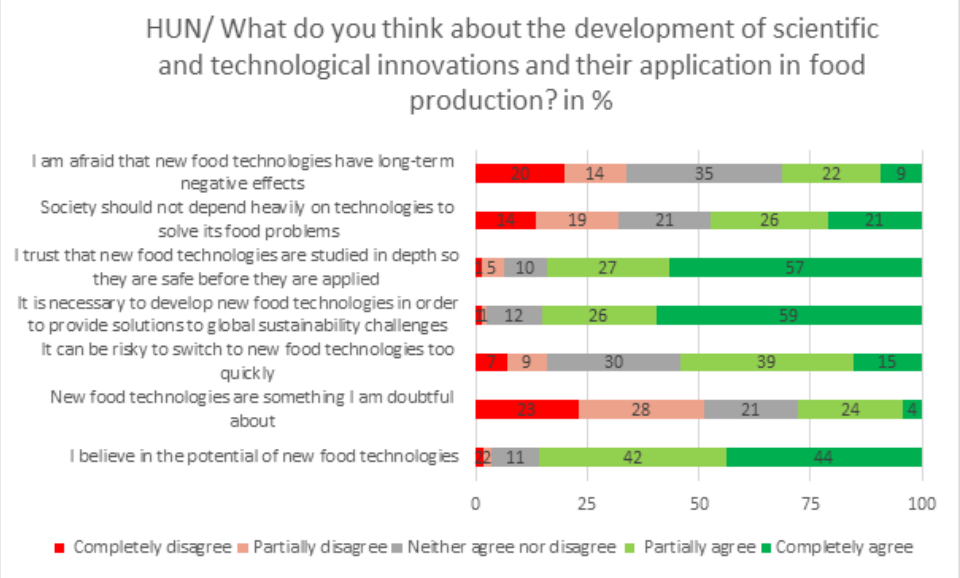


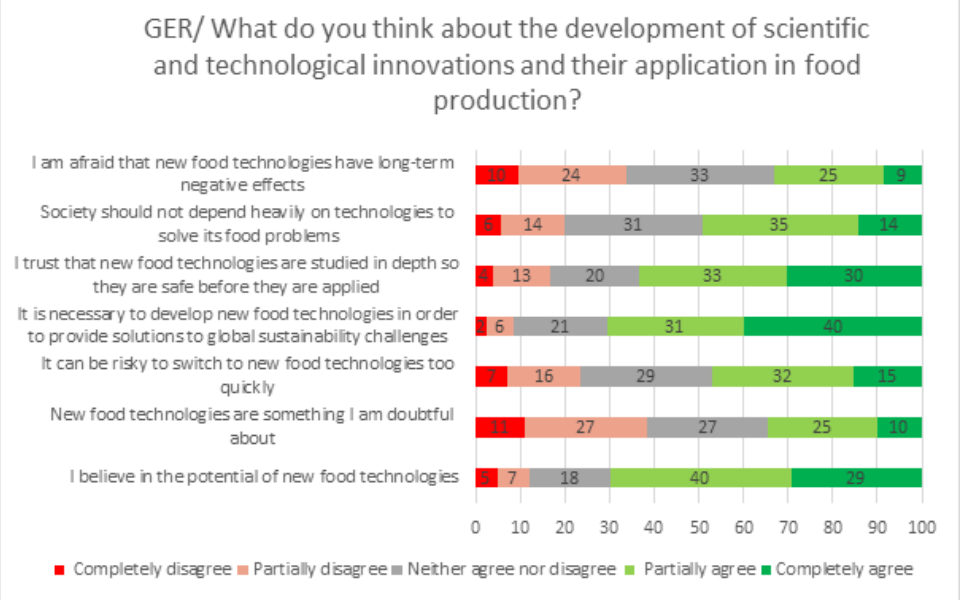
3.6 Attitudes towards scientific and technological innovations

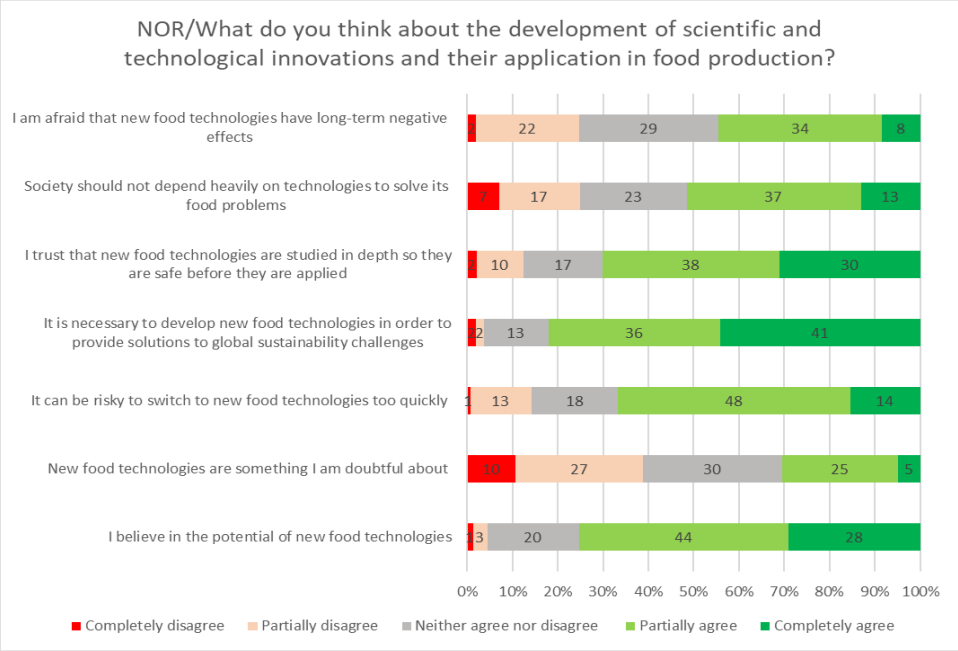
New technologies are constantly being developed so that food production and processing methods can be improved. Depending on the technology, the target of the development may be improvement of production efficiency, nutritional content, product safety or taste or products, improvement of sustainability, and / or solving global food security challenges.

In Hungary new food technologies are seen to be critical, “society should not depend on them to solve food problems” state 47% (partially and complete agreement). Hungarian consumers have high trust in new food tech (57% completely), in Germany only 30% of the consumers show that trust. “It is necessary that new food technologies are studied in order to provide solutions to global sustainability challenges”, here, 59% of the Hungarian consumers completely agree, only 40% of the German

consumers completely agree. 44% of the Hungarian consumers completely believe in the potential of new food technologies, 29% of the German consumers believe that. Norwegian consumers trust new technologies applied to the food industry, but they worried that they are too quickly brought to the market and wish they are studied before been taken into use.

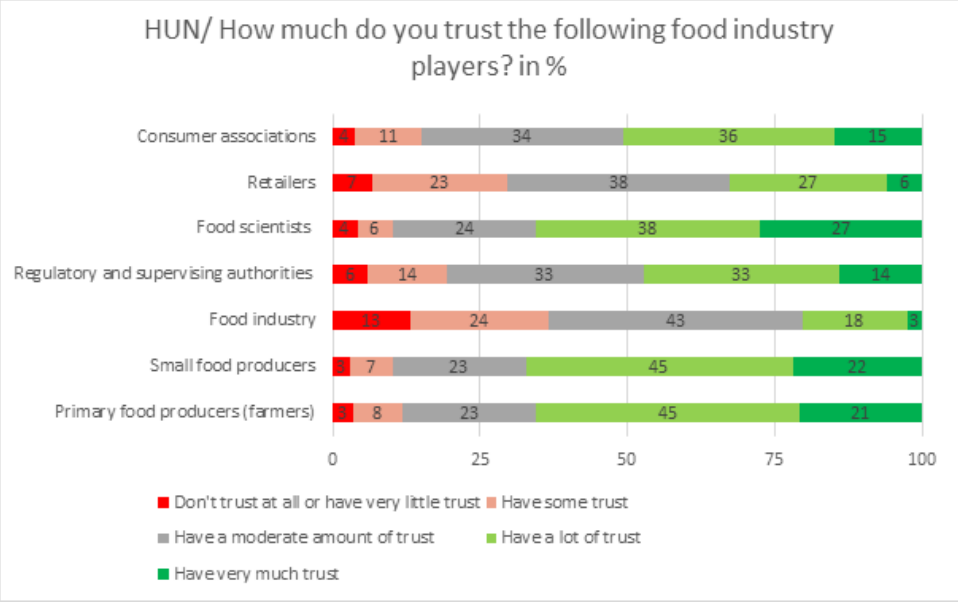


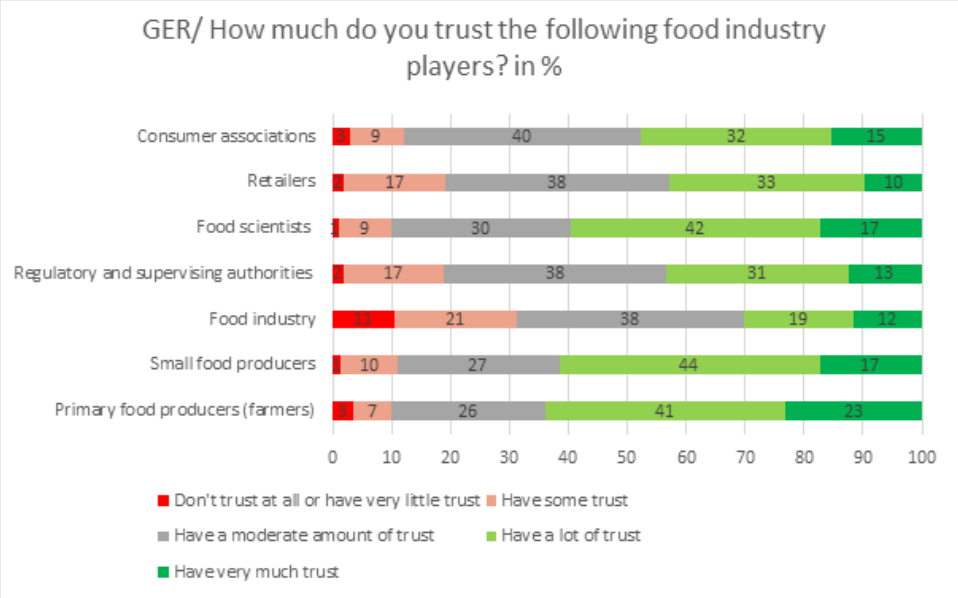


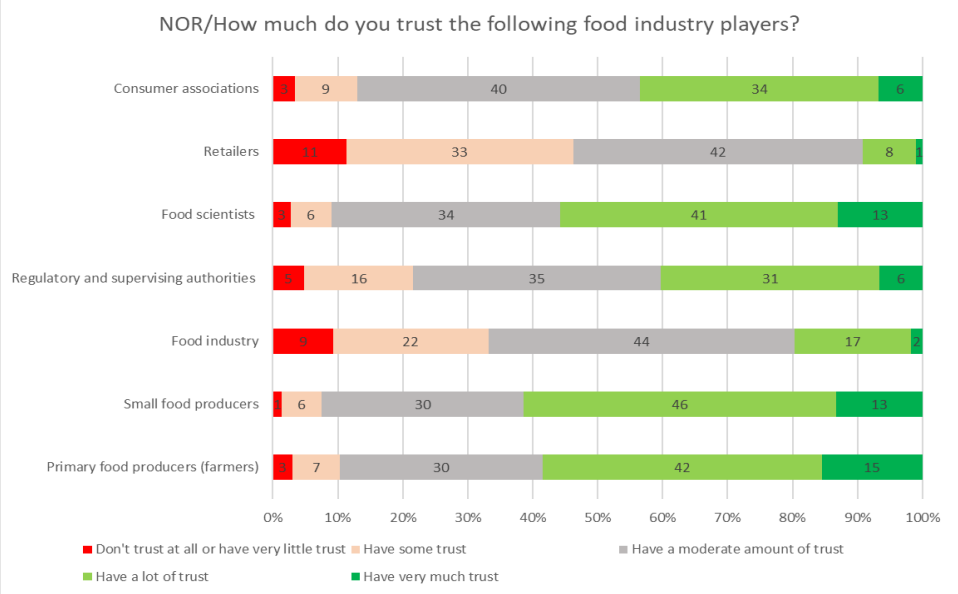


3.7 Trust in the food industry

In Germany and Hungary, the trust in the food industry is rather moderate to low. Consumers do have high trust towards small producers and farmers (HUN: moderate trust/high trust 66/67%, GER: 61%/664%). The trust in the food industry is rather low with 18% moderate trust and 3% high trust stated by the Hungarian consumer and 19% moderate trust and 12% high trust stated by the German consumer. Norwegian consumers also trust small food producers and farmers, as well as the food scientists. It is surprising the low trust on the retailer sector.



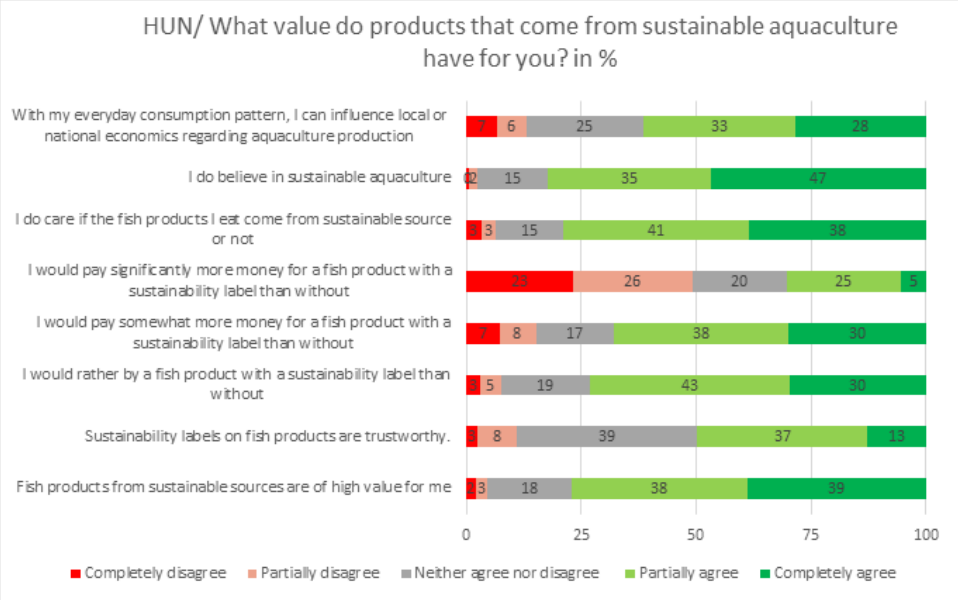


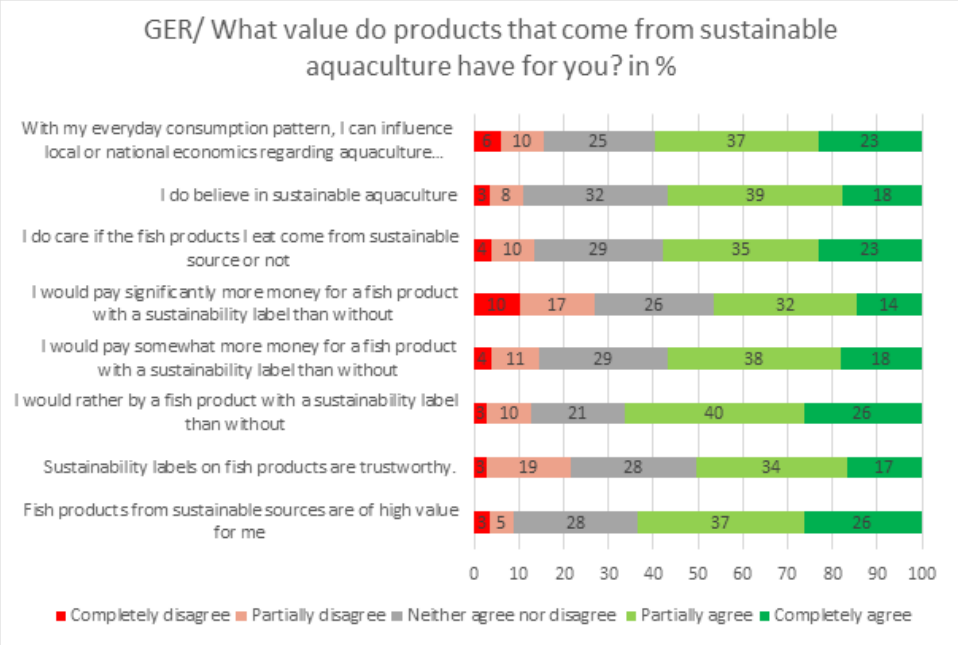


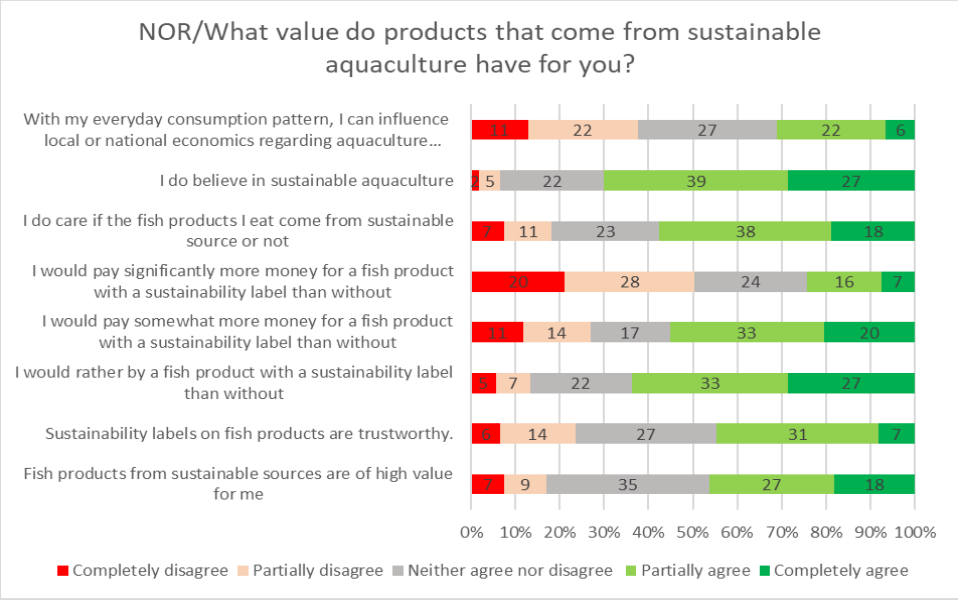
3.8 Value of products from sustainable aquaculture

Consumers in Hungary and Germany do believe, that they influence local or national economics regarding aquaculture production with their everyday consumption pattern (HUN: 33% partially agree; 28% totally agree/ GER: 37% partially agree; 23% totally agree). Consumers in Hungary show more trust towards sustainable aquaculture production with 47% complete agreement, in Germany only 18% show complete agreement. Consumers would pay more money for a product with a sustainability label but not significantly more money. 77% of the Hungarian consumers state, that products from sustainable aquaculture are of high value for them (38% partially agree; 39% total agree), the German consumer does not state that high value (37% partially agree; 26% total agree).

Norwegian consumers believe in sustainable aquaculture and would like to be able to recognise the products through a label. However, 20% of Norwegians surveyed “completely disagree” that they would pay significantly more money for aquaculture products with a sustainability label than without (similar result in Hungary, 23%).

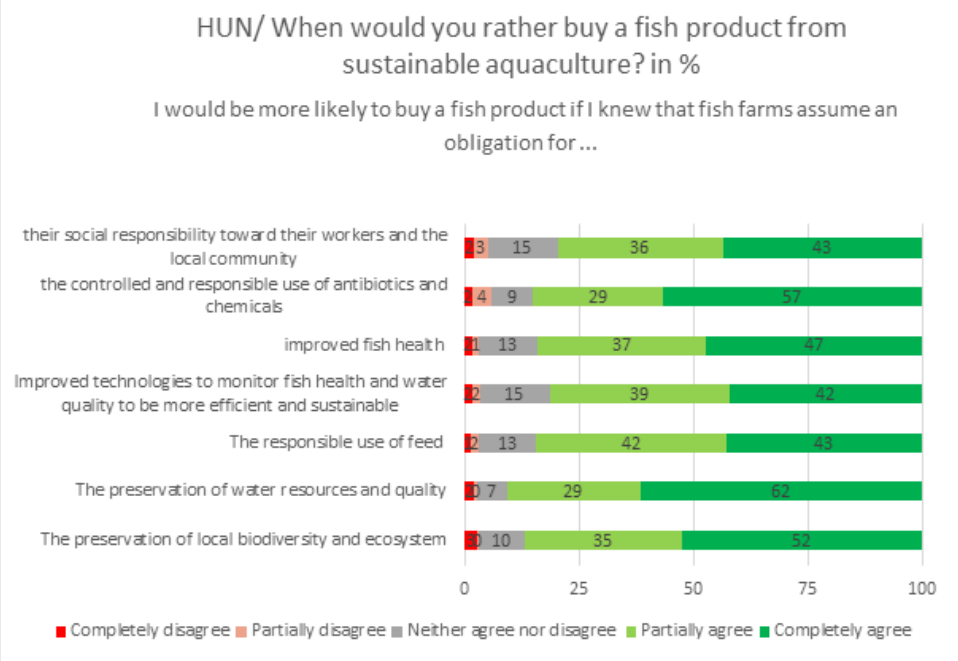

HUN/ What value do products that come from sustainable aquaculture have for you? in %
With my everyday consumption pattern, I can influence local or national economics regarding aquaculture production
7 6 25 33 28
I do believe in sustainable aquaculture
2 15 35 47
I do care if the fish products I eat come from sustainable source or not
3 3 15 41 38
I would pay significantly more money for a fish product with a sustainability label than without
23 26 20 25 5
I would pay somewhat more money for a fish product with a sustainability label than without
7 8 17 38 30
I would rather by a fish product with a sustainability label than without
3 5 19 43 30
Sustainability labels on fish products are trustworthy.
4 8 39 37 13
Fish products from sustainable sources are of high value for me
2 3 18 38 39
0 25 50 75 100
Completely disagree
Partially disagree
Neither agree nor disagree
Partially agree
Completely agree

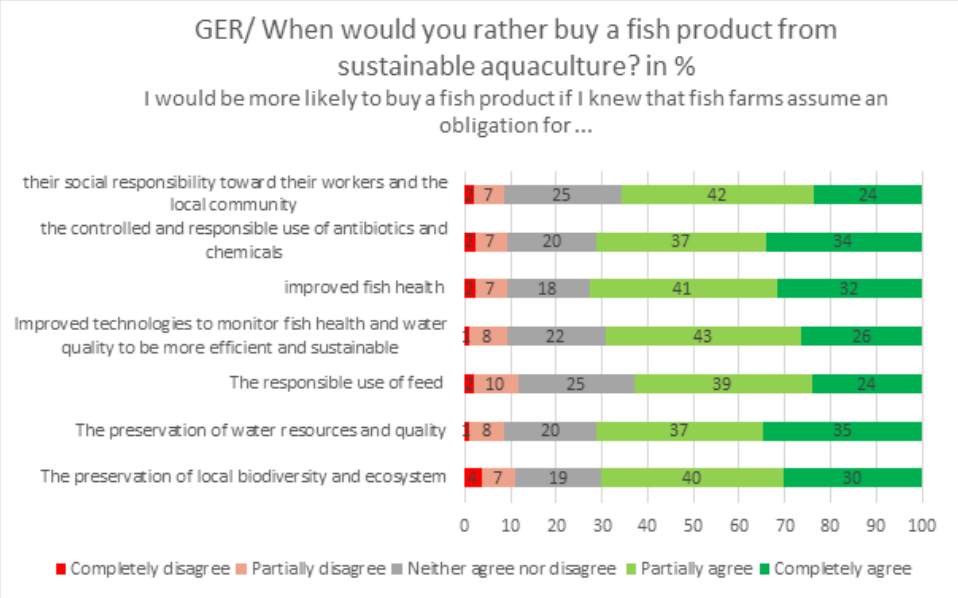

GER/ What value do products that come from sustainable aquaculture have for you? in %
With my everyday consumption pattern, I can influence local or national economics regarding aquaculture...
6 10 25 37 23
I do believe in sustainable aquaculture
3 8 32 39 18
I do care if the fish products I eat come from sustainable source or not
4 10 29 35 23
I would pay significantly more money for a fish product with a sustainability label than without
10 17 26 32 14
I would pay somewhat more money for a fish product with a sustainability label than without
4 11 29 38 18
I would rather by a fish product with a sustainability label than without
3 10 21 40 26
Sustainability labels on fish products are trustworthy.
3 19 28 34 17
Fish products from sustainable sources are of high value for me
3 5 28 37 26
0 10 20 30 40 50 60 70 80 90 100
Completely disagree
Partially disagree
Neither agree nor disagree
Partially agree
Completely agree

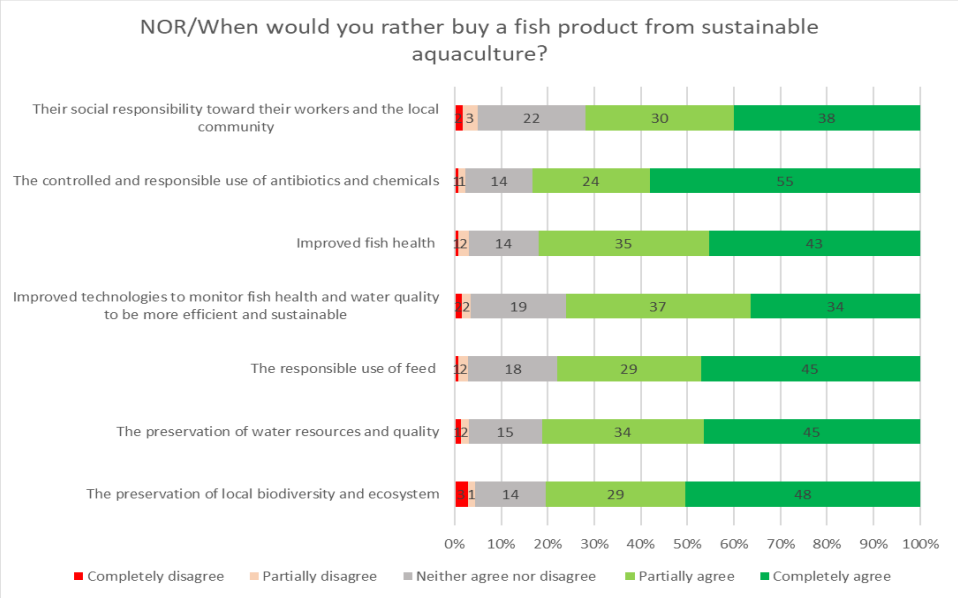


3.9 Value of principles which address to ASC standards

Social, economic and ecological standards are of high value to the consumers. Hungarian consumers are more likely to buy a fish product if they knew that fish farms take responsibilities for sustainability aspects. Partial and complete agreement is higher than 80% for all statements. The German consumer does show less agreement (partial and complete agreement 70%). Norwegian consumers also believe on the high value of the standards, especially the reduced use of antibiotics and chemicals, the responsible use of feed and the preservation of water quality.

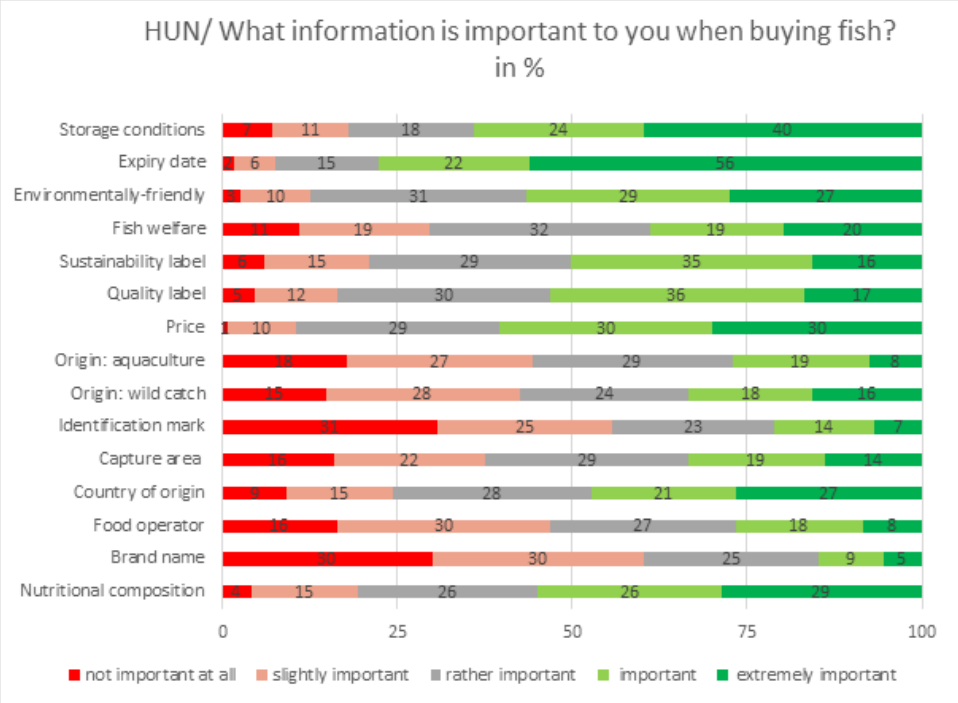


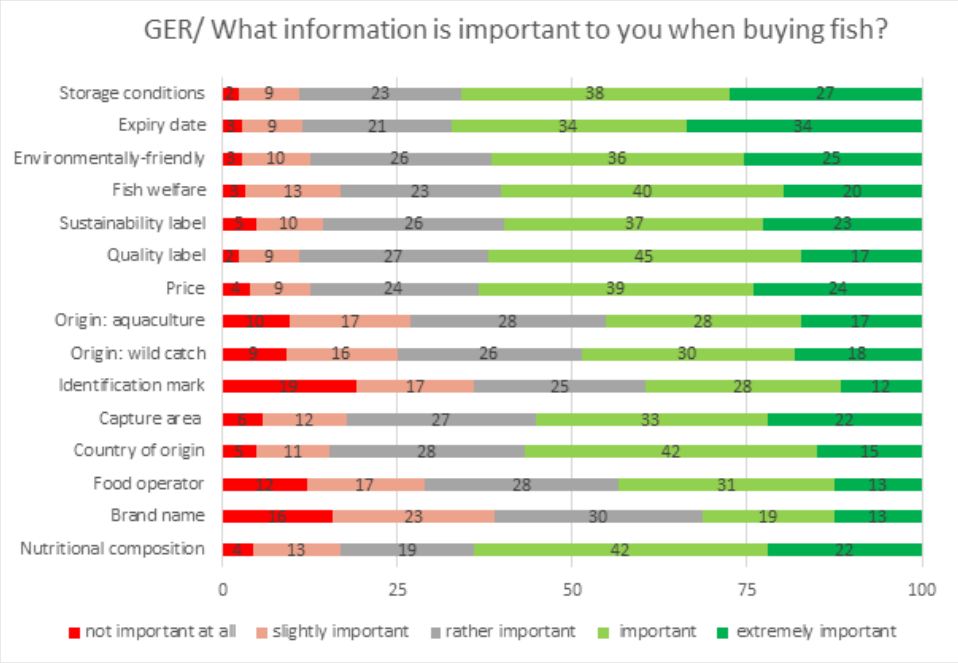


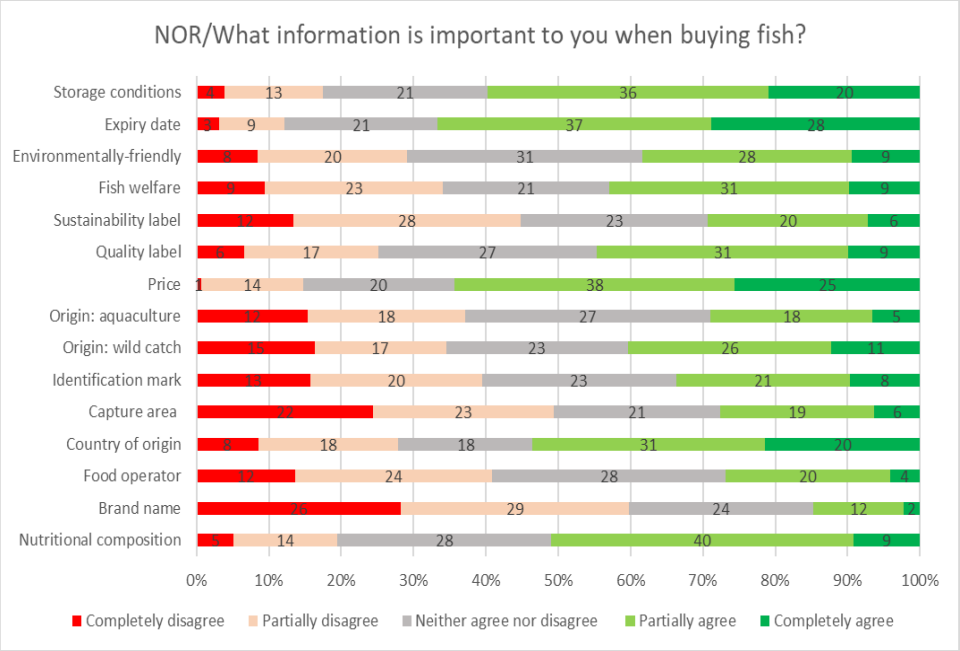


3.10 Importance of information on food

Storage conditions, expiry date, environmentally friendly, sustainability label, quality label, price and nutritional composition are the most important information for Hungarian consumers when buying fish (percentage important and percentage extremely important more than 50%). Storage conditions, expiry date, environmentally friendly, fish welfare, sustainability label, quality label, price, capture area, country of origin and nutritional composition are the most important information for German consumers when buying fish (percentage important and percentage extremely important more than 50%). Price, country of origin, expiration date and storage conditions are the top information required by Norwegian consumers.


HUN/ What information is important to you when buying fish?
in %
Storage conditions 7 11 18 24 40
Expiry date 4 6 15 22 56
Environmentally-friendly 5 10 31 29 27
Fish welfare 11 19 32 19 20
Sustainability label 6 15 29 35 16
Quality label 5 12 30 36 17
Price 1 10 29 30 30
Origin: aquaculture 18 27 29 19 8
Origin: wild catch 15 28 24 18 16
Identification mark 31 25 23 14 7
Capture area 16 22 29 19 14
Country of origin 9 15 28 21 27
Food operator 16 30 27 18 8
Brand name 30 30 25 9 5
Nutritional composition 4 15 26 26 29
0 25 50 75 100
not important at all
slightly important
rather important
important
extremely important


GER/ What information is important to you when buying fish?
Storage conditions 2 9 23 38 27
Expiry date 3 9 21 34 34
Environmentally-friendly 3 10 26 36 25
Fish welfare 3 13 23 40 20
Sustainability label 5 10 26 37 23
Quality label 2 9 27 45 17
Price 4 9 24 39 24
Origin: aquaculture 10 17 28 28 17
Origin: wild catch 8 16 26 30 18
Identification mark 19 17 25 28 12
Capture area 6 12 27 33 22
Country of origin 5 11 28 42 15
Food operator 12 17 28 31 13
Brand name 16 23 30 19 13
Nutritional composition 4 13 19 42 22
0 25 50 75 100
not important at all
slightly important
rather important
important
extremely important



4 Results of Choice experiments (Willingness to pay) in Germany, Hungary and Norway

We designed Choice Experiments to understand consumer acceptance of new technologies/ innovations in aquaculture. Consumers of fish and seafood products derived from European Aquaculture were invited for this survey.

The objectives of this approach are to study the consumers' willingness to pay food products of the European Aquaculture Sector which are processed with innovative technologies. Our focus was on new technologies (iBOSS), sustainability aspects and different labelling methods.

For this study, we used the Choice Modeling method, described in iFishIENCi Deliverable 4.1, to model the decision process of an individual in our iBOSS context.

This study was carried out with 300 consumers in Norway, 237 consumers in Hungary and 208 consumers in Germany. They had to fulfill the following criteria: Consumers of fish or seafood products / specific age distribution / gender distribution / responsible for food shopping and preparation in the household.

Stimuli for Choices

The following stimuli were in the choice-based conjoint study:

- Price
- Sustainable production
- Applied circularity
- Production method (organic or not organic, only in Germany)
- High-end quality (salmon, only in Norway)

Rainbow trout, 125g					
price	price in EUR	production method	sustainability	circularity	high end quality (sushi)
-0,25	1,49	organic	sustainable production	applied circularity	
average	1,99	not organic	no information	no information	
+25%	2,49				
average organic	4,69				
+25%	5,89				
African Catfish, 500g					
price	price in EUR	production method	sustainability	circularity	high end quality (sushi)
-0,25	2,8		sustainable production	applied circularity	
average	4,1		no information	no information	
+25%	5,1				
Atlantic Salmon					
price	price in NOK	production method	sustainability	circularity	high end quality (sushi)
-0,25			sustainable production	applied circularity	high end quality
average			no information	no information	no information
+25%					

The price dimensions will be country-specific as it highly varies between them. To define a standard, the give percentages below and above average a standard will be used in every country.

4.1.1 Design of the choice situation for the choice experiments

We divided the different stimuli into different choice sets, which were evaluated by each participant. The number of choice sets depended on the number of stimuli and adjusted correspondingly.

Example of choice sets given:

soSci
oFb - der onlineFragebogen

22% kész

7. Kérjük, jelezze, hogy melyik terméket vásárolná meg szívesen.
Kérjük, kattintson a megfelelő képre.

1599 HUF
fenntartható
-

1199 HUF
fenntartható
-

1599 HUF
-
körforgásos gazdálkodás

Tovább

3. Welches Produkt würden Sie einkaufen?
Bitte klicken Sie auf die entsprechende Abbildung.

Forelle 125g
4,69 Euro
Bio
Nachhaltig produziert
Angewandte Kreislaufwirtschaft

Forelle 125g
5,89 Euro
Bio
-
Angewandte Kreislaufwirtschaft

Forelle 125g
4,69 Euro
-
Nachhaltig produziert
Angewandte Kreislaufwirtschaft

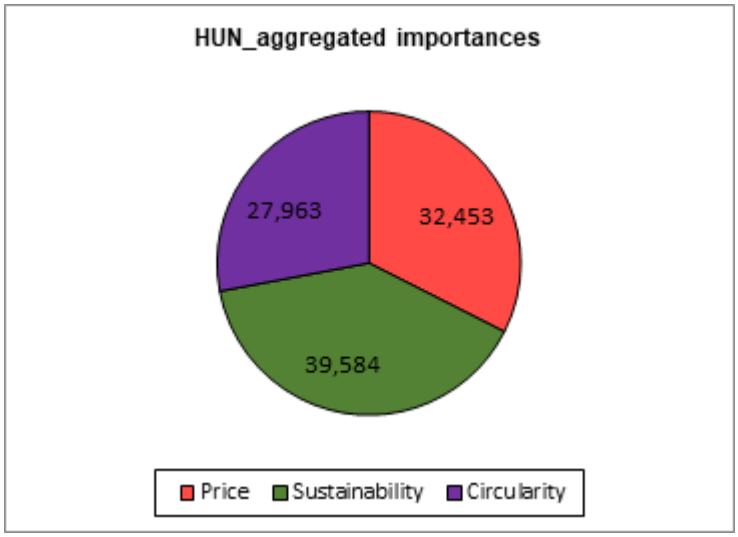
Weiter

1	2	3
82 NOK	82 NOK	103 NOK
Sashimi kvalitet	Ikke Sashimi kvalitet	Sashimi kvalitet
Bærekraftig produksjon	Bærekraftig produksjon	Ikke Bærekraftig produksjon
Produsert med prinsipp fra sirkulærøkonomi	Produsert med prinsipp fra sirkulærøkonomi	Produsert med prinsipp fra sirkulærøkonomi

The choice sets were presented in random orders.

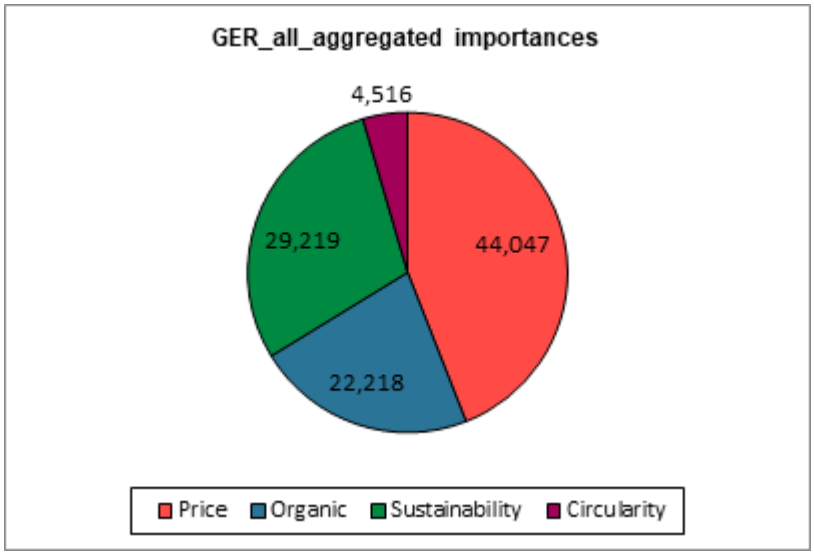
4.2 Hungary

The choice experiments in Hungary with 237 consumers did show that sustainability is the most important factor for consumers when buying a fish product, price is the second important factor. The advantage of sustainability is higher than the disadvantage of a high price. The highest market share has a medium-priced product which is sustainable produced and circularity is applied.



4.3 Germany

The choice experiments in Germany with 208 consumers did show that price is the most important factor for consumers when buying a fish product, sustainability is the second important factor, third is organic. The lack of sustainability has a negative effect on the choice. The highest market share has a medium-priced product which is sustainable produced, not organic and no circularity is applied.



4.4 Norway

The choice experiments in Norway with 300 consumers showed that price is the most important factor for consumers when buying a fish product, sustainability is the second important factor, and the third most important factor is if the salmon filet is sushi-grade quality (the Norwegian market proxy for "organic» quality). We see that the lack of the use of "sustainable aquaculture methods" (proxy for iBOSS) has a negative effect on the choice.

Of the simulated products in the choice survey, the product with the highest market share was the Atlantic Salmon product with a price of 38NOK/200g, not sushi-quality, and sustainably produced.
If this product was not available, a product for 82NOK/200g, sushi-quality and sustainably produced received the highest market share.

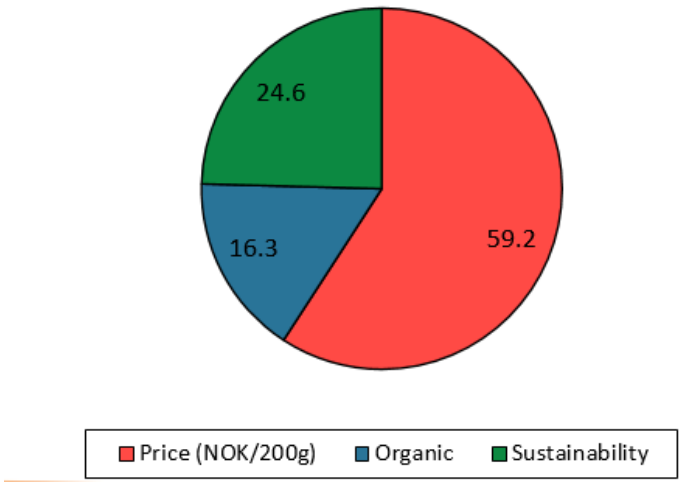


Figure 1: Results from the Norwegian Choice Experiment (N=300 consumers) and their product factor preferences.

5 Consumer insight based on the choice experiments

The main advantage of conjoint analysis is that it allows to simulate a market even if the products in the market have not been tested by the individuals. In our case, the market for a fish products is analysed and we would like to investigate the impact and market shares the introduction of a new product would have.

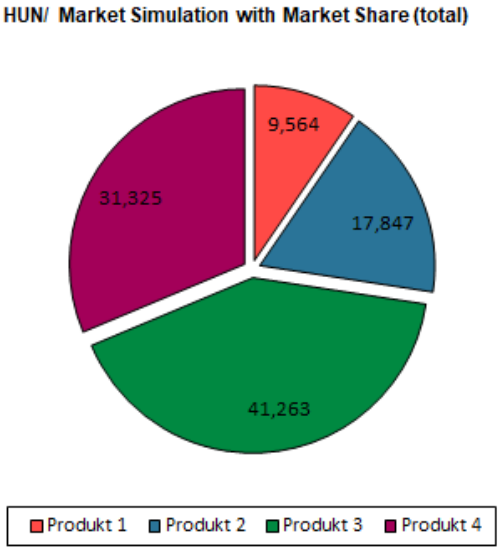
Based on market conditions and the aggregated utilities, four products were designed for a market simulation.

5.1 Hungary

Highest utilities received sustainability and price. We did choose a product for a low price of 2,80 EUR with no additional information about sustainability or circularity, and a higher priced product, sustainable bred and circularity applied and two products sustainable bred but no circularity applied. The following table shows the simulated market.

The highest market share has a medium-priced product (4,10 Euro), which is sustainably produced and circularity is applied (Product 3).

Product ID	Price (HUF)	EUR	Sustainability	Circularity
Product 1	1199	2,80	no sustain	no circularity
Product 2	1599	4,10	sustain	no circularity
Product 3	1599	4,10	sustain	circularity
Product 4	1199	2,80	sustain	no circularity

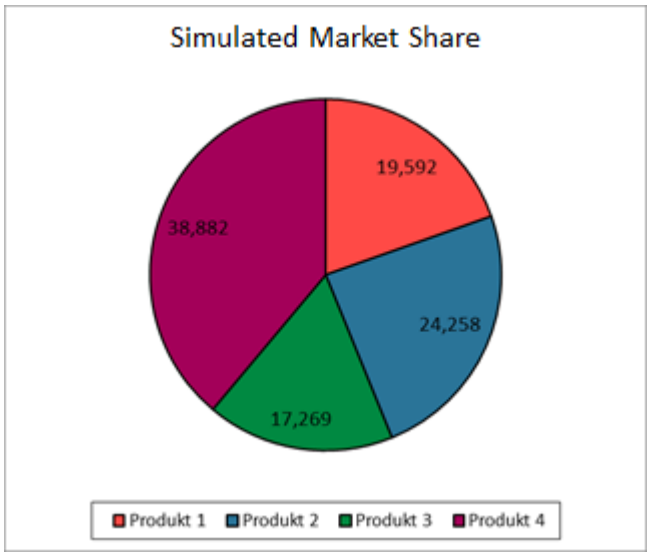


5.2 Germany

P4 with highest utilities is a sustainable, non-organic product for 2,49 EUR. We know that in today's market there are several fish products that have different characteristics. We did choose a product for a low price of 1,99EUR with no additional information about sustainability, and a high price product, organic and sustainable bred and a medium-priced organic product not sustainable bred. The following table shows the simulated market.

Simulated market

	Price (€)	Organic	Sustainability	Circularity
P1	1,99	not organic	not sustainable	no circularity
P2	5,89	organic	sustainable	no circularity
P3	4,69	organic	not sustainable	no circularity
P4	2,49	not organic	sustainable	no circularity



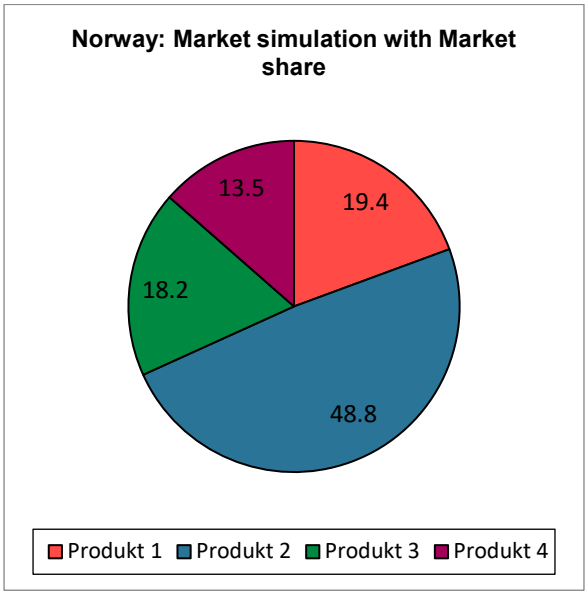
The highest market share has a medium-priced product (2,49 Euro), which is not "organically" produced but is "sustainably" produced, and where no circularity is applied (Product 4).

5.3 Norway

For Norway, the product that had the highest market share (49%) was 38 NOK/200g, not sushi-grade, but made in a sustainable way. The worst market share was the product that had the highest price (103 NOK7200g), sushi-grade and sustainable farmed. We know from previous studies that Norwegians have a high-price aversion, so this result was expected.

Product identifier	Price (NOK/200g)	Sushi-grade	Sustainability
Produkct 1	29	not Sushi-grade	not sustainble
Product 2	38	not Sushi-grade	sustainble
Product 3	48	not Sushi-grade	sustainble

Product 4	103	Sushi-grade	sustainble



6 Social Acceptability under real shopping - Willingness to buy experiments

Eye-tracking experiments were conducted with 14 retail-consumers in Germany in December 2022. Detailed information and interpretation of the data can be found in D4.14.

The main question was what triggers the intention to buy a product. Results show that consumers show a higher buying intention for products with sustainability labels than for the one product without a label. But the focus of the consumers as shown in the heat maps and their answers in the questionnaire is not driven primarily by the existence of a label, rather appealing design, the portions size, the Nutri-Score, the WWF label or other information they are familiar with. Consumers do know the MSC Label, but some are still not aware of the ASC label as a label for sustainable aquaculture, which is highlighted in the reasons for not- buying the ASC product: “no sustainability label, no information about catch, no breeding information, label looks not trustworthy”. Only one person out of the 14 testers mentioned the ASC label directly as a reason for buying the product. Consumers are influenced by the supermarket and the trades they know and trust. Consumers are not familiar with the GGN label, they rather respond to the wording on the package rather than the label. The heat map confirms these results. Here, hardly any attention was given to the label GGN. In case of the Naturland label (organic label) the consumers did fix the „Planet Pro Info“ and the Nutri-Score more often than the label Naturland (which was only known by six of the consumers). In contrast to the sustainability labels for aquaculture, the MSC label receives more attention. The MSC label is known to 13 people and is recognized as an established seal of quality. Only three consumers would buy the fish product without a label. Consumers miss information and feel the package as not trustworthy and cheap. The first question addressed information which is important to the consumer when buying salmon filets. Only one person named the ASC label and one person named the MSC label. From this one can conclude that the importance of sustainability seals and the conscious purchase of these is rather low. During the research, the labels were brought closer to the consumers and the consumers worked with them. This and the information about the ASC label and the underlying principles could have promoted the importance of sustainability towards the end of the study. Consumers are interested in social and ecologic responsibility. Consumers do care for ecological effects such as biodiversity and the quality of water resources. Further, consumers are interested in animal welfare and the responsible use of antibiotics and chemicals. All of them agree to their ability to influence the developments towards sustainable aquaculture through their shopping behaviour. Consumers see greater value in purchasing products with the ASC label or other sustainability labels, but still it is no priority for them when buying a fish product. They consider the ASC label as trustworthy, but do not set their focus on it when buying a product.

Food packages presented to the retail-consumers:

7 Sensory acceptance

Different organoleptic tests were conducted with retail consumers. Detailed information is given in D3.6.

The aim of this organoleptic study was to examine the sensory acceptance of different fish fillets. Samples derived from different fish species which were fed with feeds produced in the project (algae/insect/ bioactive compounds).

- Laos 02.2012 (n=14; acceptance and CATA, tilapia)
- Laos 11.2021 (n=14; acceptance and CATA, tilapia)
- Germany; TTZ 08.2022 (n=21; acceptance and RATA, Rainbow trout)
- Hungary, GE/MATE, 01.2023 (n=21; acceptance and RATA, African catfish)

In general, we can conclude that the new feeds had no significant influence of the sensory acceptance of the consumers.

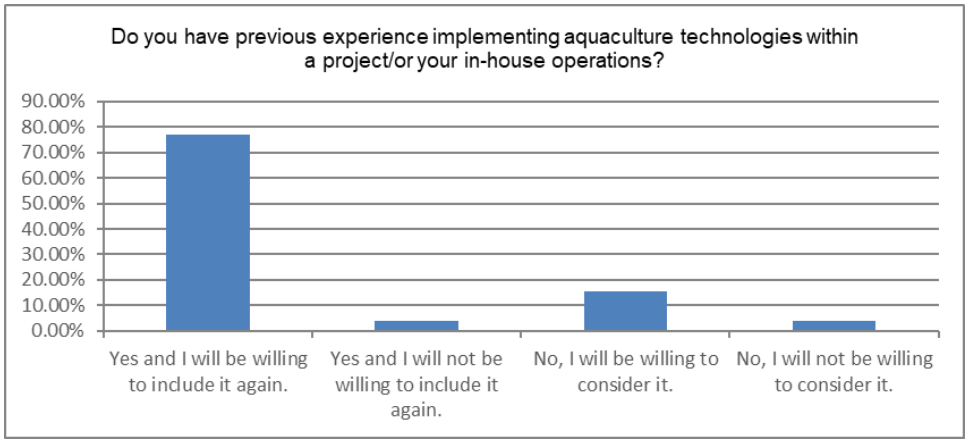
8 Relevance to marketing of the iBOSS iFishIENCi product

The results of the overall social acceptance analysis show that sustainability is an important factor for consumers. Moderate higher prices are tolerated by the consumer to eat and consume more sustainably. These insights are relevant to the start of a pricing mechanism for iBOSS as a single product or a compilation of component-products.

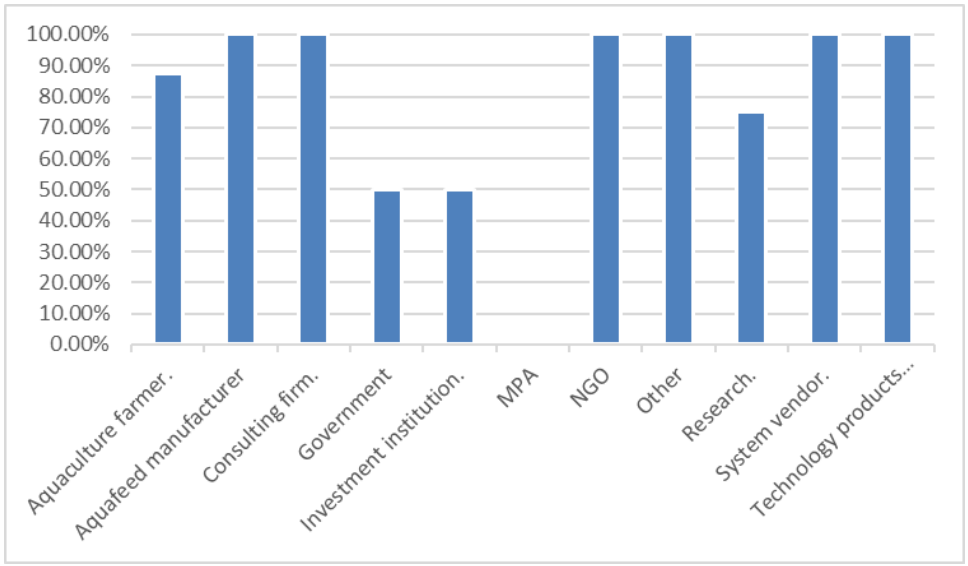
In addition to the social acceptance analysis, from a marketing point of view it is important to consider the stakeholders experience and willingness to adopt aquaculture technologies, the current adoption rate of aquaculture technologies and the challenges that need to be addressed with aquaculture technologies such as iBOSS. For this end, in WP5 a survey was launched to identify those aspects within the main stakeholders and the business enablers of the iFishIENCi products (Individual farmers, technology developers, feeding companies and investors/policy makers).

The survey allowed the identification of the level of engagement of the business enablers on current aquaculture technologies, and their willingness to implement these technologies in projects or in-house operations. The survey gathered information of the stakeholders from 15 different countries in Europe, Asia, South America and Africa (n=26). Results show that 92.30% of the stakeholders are willing to adopt aquaculture technologies.

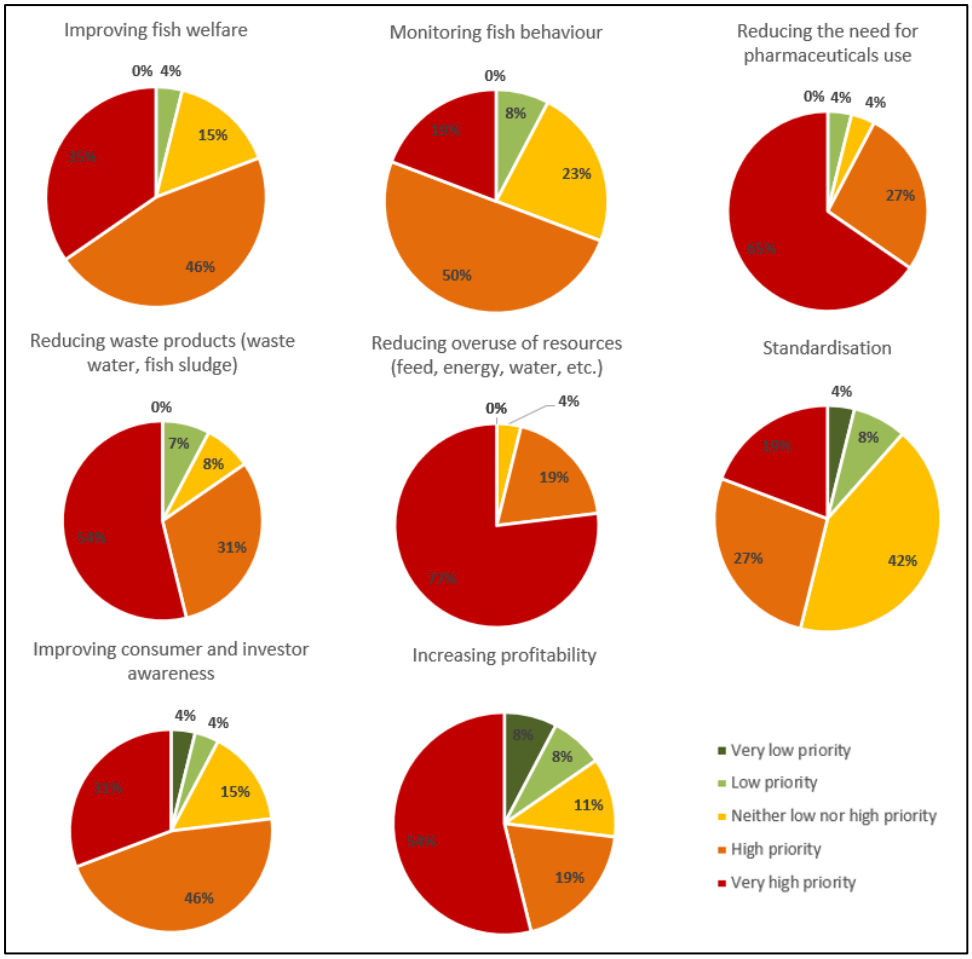
Figure below shows the stakeholders experience and willingness to adopt aquaculture technologies, it displays that 80.77% of the stakeholders have implemented some type of aquaculture technology and from that share only a 3.85% will not be willing to implement it again. 19.23% of the stakeholders indicated that they had never implemented any aquaculture technology and from this group only 3.85% showed no interest in its implementation.



It was possible to identify that some groups have not yet implemented any type of aquaculture technology, 50% of the surveyed Aquaculture farmers, Government bodies, Investment institutions, and Marine Protected Areas MPAs had never implemented or supported any aquaculture technology. The groups with the lower implementation rates should be addressed with more strong strategies in order to achieve better implementation results, on the other hand, the approach for the stakeholders with higher implementation results should consider a detailed demonstration of the competitive advantages and value added of the project results, the top implementation groups include Aquafeed manufacturers, Consulting firms, NGOs and System vendors with 100% of the each group already implementing some aquaculture technology, other groups such as the Aquaculture farmers and research institutions have an implementation rate of 87.5 and 75% respectively. Figure below shows the stakeholders aquaculture technologies adoption rates.



To identify the needs and aspirations of these stakeholders regarding the aquaculture technologies the main aquaculture challenges to be solved by the technology providers were assessed. Figure below introduces the results of the survey on the main 8 prioritised challenges to be solved.



It is necessary to emphasise the high importance of reducing the overuse of resources (feed, energy, water, etc.) for the business enablers and in general for all the stakeholders, according to the results of the survey this challenge was identified as a very high priority by 77% of the stakeholders.

After the need of reducing the overuse of resources, the reduction of the need of pharmaceuticals use was identified as the second most important challenge to be solved by the technology providers, this aspect was found as very high priority by 65% of the respondents. The survey results show that reducing the need for pharmaceuticals by aquaculture 5.0 technologies is considered a high priority or very high priority by most of the surveyed organizations.

The survey results show that the reduction of waste products is considered a very high priority for most of the organizations surveyed (54%). Specifically, Aquaculture farmers have a high priority of 37.5%, while 25% of them consider it neither low nor high priority and 37.5% consider it a very high priority. Aquafeed manufacturers and system vendors consider it a very high priority (100%).

Increasing profitability, as in all business, is of great importance for the identified business enablers and in general for all the stakeholders, this aspect was identified as a very high priority for 54% of the respondents. The survey results show the priorities of different types of organizations in terms of increasing profitability through aquaculture 5.0 technology providers.

Improving fish welfare was determined as very high and high priority by 54% and 19% of the respondents respectively. It is clear that different types of organizations have varying priorities when it comes to improving fish welfare through aquaculture 5.0 technology providers. Aquaculture farmers

had a high priority (62.50%) and very high priority (25.00%) for improving fish welfare. Only 12.50% of them had a neither low nor high priority for this challenge.

Monitoring fish behaviour was classified as very high priority and high priority by 19% and 50% of the respondents respectively. Aquaculture farmers had the highest percentage of respondents who considered it a high priority (62.50%) and a notable 25.00% considered it a very high priority. Only 12.50% of farmers considered it a low priority.

Standardisation was classified as very high priority and high priority by 19%% and 27% of the respondents respectively. The survey results show that the priorities of different organizations in the aquaculture industry vary when it comes to addressing the challenges that can be solved by aquaculture 5.0 technology providers. Specifically, the challenge of standardization was not viewed as a significant priority by all stakeholders.

Finally in this survey, improving consumer and investor awareness was classified as very high priority and high priority by 31% and 46% of the respondents respectively. According to the survey results, improving consumer and investor awareness was a priority for most organizations in the aquaculture industry.

9 Conclusions

In summary, the social acceptability analysis in Task 4.1 was tightly constrained by the low TRL and demonstration delays of iBOSS. No iBOSS "product" could thus be assessed with aquaculture consumers. So, it was not possible to conduct a before/after survey to judge the improvement of consumer awareness and acceptability (KPI: *"Increase consumers' positive perception and acceptability by 10% through before-after test trials (using the established workshops"*). However, our initial focus group which informed our follow-up online of 208 Germans, 237 Hungarians and 300 Norwegians provided a rich data set in Deliverable 4.2 and gained insight into the topics of consumer preferences and perceptions of sustainability and risk. Specifically, Germans and especially Hungarians surveys, show a high interest and trust in the iBOSS and Waste2Value methods. This lends a good indicator for product investors that are needed to further the TRL of iBOSS after the end of the iFishIENCi project. In this way, the results from the survey should be used in furthering the TRL of iBOSS and Waste2Value by while improving the acceptability of farmed fish through better practices (lower environmental footprint of the aquaculture industry and organic aquaculture, etc.), thereby increasing the market share of fish-farmed versus wild-fish harvesting.